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# Electronics

**AUSTRALIA** WITH Professional Electronics & ETI

MARCH 1998

## PIONEER'S NEW CD AUDIO RECORDER: HANDS-ON TEST

**MAKES IT EASY TO  
RECORD YOUR OWN CD'S**



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NZ \$7.50 (inc GST)



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**REVIEW OF CANON'S NEW  
MV-1 DIGITAL CAMCORDER/CAMERA**



# Where do you GO for scope and vision in electronics...

*You go to the name that's been around the longest to get the latest products.  
The most experienced company with the newest look.*

## Legend card 64 mi TV tuner

This legendary all-rounder performs a number of functions: that of video card, TV tuner card and MPEG card. Operates on full-screen or windows, input from cable/satellite, TV, VCR or camera, outputs to composite, s-video and standard TV monitor. Can link to 3DFX pass-through card. Graphic Controller ARK2000Mi, Bus Architecture PCI, DAC Integrated, 2MB EDO RAM. Windows 95. Xing MPEG viewer supplied. Streaming video capture, resolution 320 x 240 pixels, and frame rates 24 per second. Recommended systems P133, 8-bit colour palette at 160 x 120 at 15fps.

**Manufactures five-year warranty.**

X 8137



**\$379**

## Digital Video Disc player

Enjoy movies, PC games and music like never before. This creative DVD kit includes internal PC-DVD ROM driver, DXR2 MPEG-2/Dolby digital (AC-3) decoder board with audio and video loopback cable, s-video/composite video cable, 40-pin data cable and CD audio cable. Runs on Windows 95.

XH 0024



**\$799**

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Continuous autoset, glitch capture down to 40 ns, video triggering (also non-interlaced), envelope mode min max, measure amps with optional current clamps, advanced measurements, Diode test and continuity beeper, DMM measurements with waveform, back-lit display, optically isolated RS-232C, on-line information screens. Safety designed for measurements on 600 V industrial power systems with included probes.\*

**Only two left in stock  
at this fantastic price.**

**\$1495**

Q 1645

\*These two products available only through Direct Link or the Dick Smith Electronics' PowerHouse store in Bankstown.



## Tektronix TDS-220 100MHz Cro

This digital real time Oscilloscope captures what analogue CROs can't! Measures up to 100 MHz, has two channels plus an external trigger input, 1 GS/s sampling per channel, auto setup, full dual timebase with powerful zoom facilities, variable hold-off for triggering complex waveforms. Also reference waveform memories, cursor measurements and automatic measurements such as frequency, period, cycle RMS and mean peak-to-peak. Display modes include dots, continuous line and variable persistence.\*

Q 1817

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# Electronics

Volume 60, No. 3  
March 1998

**AUSTRALIA** WITH Professional Electronics & ETI

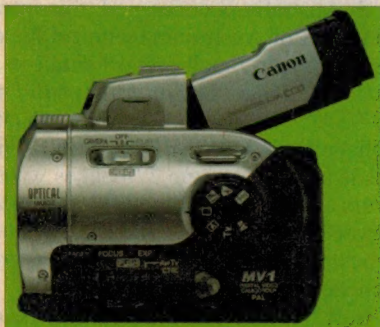
AUSTRALIA'S LARGEST SELLING ELECTRONICS MAGAZINE — ESTABLISHED IN 1922

## Impressive babies



EA's technical editor Rob Evans was very pleasantly surprised when he ran the new JC25 compact low-cost bookshelf speaker system from Jaycar Electronics through its paces. He discovered a level of performance which compares very well with much more expensive systems. You'll find his review starting on page 24...

## Takes still images, too



Canon's new MV-1 digital camcorder shows how video and still camera technologies are converging. It takes still images as well as excellent digital video and audio. See page 14 for Barrie Smith's review.

## On the cover

Until very recently, audio CD recorders were well beyond the budget of most people. But Pioneer's new PDR-04 recorder is more affordable, and also makes it surprisingly easy to make your own CDs. Louis Challis has been trying one out — see his review, starting on page 10. (Photo by Greg McBean)

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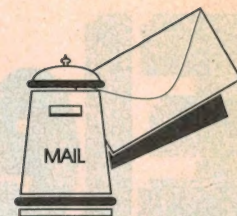
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# LETTERS TO THE EDITOR



## Computer intelligence

I was interested to see the old Artificial Intelligence debate rearing its head again. (Letter from Peter Stuart, Information Centre, EA Oct 97.)

I for one believe that computers cannot think. A thought is completely immaterial, so cannot simply consist of some arrangement of physical things. The Greek philosopher Aristotle used this as an argument for the existence of the soul.

But is the human brain like a computer? No, it isn't. If you want a scholarly but readable book dealing with these questions, get yourself a copy of *Brain, Mind and Computers* by Stanley L. Jaki — ISBN 0-89526-907-4, Gateway Editions, available from Portico Books (02) 9980 8836. In this book, Jaki states that 'The data of brain research... play havoc time and again with efforts to establish the identity of computers and brain'.

Good on you Peter Stuart — the 'more qualified' are onside with your common sense!

**Matthew Murphy, PEng.**  
Pennant Hills, NSW.

## No rotation!

I must spring into action and issue a warning against a dangerous suggestion (page 5 *Electronics Australia* January 1998) under the heading 'Christmas lights'. Eric van de Weyer of Vacluse, NSW suggested 'when mounting the mains sockets on the side of the box, orientate them at 45 degrees clockwise from the vertical position, as this will enable most side-entry plugs to be used as well as bottom-entry ones'.

I then turned to page 60 of the November issue and saw the position of the sockets. (Hopefully the picture is shown upside down). It is not allowed by the local Authorities, Western Power, to mount a socket upside down or at any angle. I spoke to an Inspector who confirmed my concern. Orientation in a clockwise direction: Earth at six o'clock, Active at 10 o'clock and Neutral at two o'clock, all viewed from the front of the outlet.

The Earth pin is longer than the Active and Neutral, so it will break the circuit last, however when mounted on

an angle the active could easily break last. The relevant regulation is: Australian Standard 3000 rule 4.14.8; this rule further points to Fig.2.1(a) of AS 3112.

This may be seen as 'nitpicking', however it is important to get it right as many electrical apprentices read *Electronics Australia* and could easily get bad habits before sitting for their final test.

**J. Johansen,**  
Noranda, WA.

## Radio in other states

I refer to Mr E.H. Wilkinson's letter (*EA* December 1997) in which he refers to the commencement of radio broadcasting in Australia and asks the question 'What about Adelaide, Brisbane and Hobart?'

In my book *Australian Radio: The Technical Story — 1923-1983*, published in 1984, the establishment of MF broadcasting in all states is covered briefly in the relevant sections. However, and particularly so far as South Australia is concerned, this interesting part of Australian technical history is set out in much greater detail in *A History of Radio in South Australia — 1897-1977*, written by John F. Ross and published in 1978 (ISBN 9595852-0-6). This is a book of some 270 pages which covers all facets of radio in SA in a most comprehensive manner and it carries my highest recommendation to anyone interested in these activities.

I trust that this information may be of interest to some of your readers.

**Winston T. Muscio**  
Leumeah, NSW.

## Counter module

Regarding the flexible counter module published in January 1998 *EA*, there are a couple of little things that I have come across in the past with such designs.

The first is that many of the standard BCD-seven segment decoders do not show tails on the 6 and 9 (i.e., segments 'a' and 'd' respectively). The 4511 is one of them. I have gotten around this problem by programming a small 32 x 8 PROM with my own codes so the digits show up more clearly. A drawback is that an extra buffer is required to drive



the segments, but on the other hand you can display any code you like that is possible with a seven segment display.

The second is that as digits are added the current consumption adds up too, and a hefty supply may be needed to run an 8 - 10 digit display! I know simplicity is the object of this design at the expense of power consumption, but have you considered multiplexing the display? All the CMOS chips probably consume less than one segment of one display. Alternatively a 4026 could be used to get nice 6's and 9's, but this chip has a lower output drive than the 4511.

I hope these suggestions are useful.

Salvatore Sidoti  
Lilyfield, NSW.

### Oven detector

I bought a mobile phone so I could stay in touch with my widowed mother, and my sister in Queensland. But I was having trouble hearing it ring when I was at work, so I bought a mobile phone Vib-Alert digital vibrator from Dick Smith Electronics.

Not long after I got the phone vibrator, I was at morning tea and it started to vibrate. It startled me at first, then I realised what it was. I took the phone out of its pouch, but it was not ringing. I thought: why did the vibrator go off?

I put the phone back into its pouch. Then it did it again. I finally worked out it was our microwave oven that the vibrator was picking up. The vibrator goes off when I'm about 1m from a working microwave oven. I tried it with other working microwave ovens, and they all make the vibrator go off.

So does this mean that mobile phones do give off microwave energy? Does it also mean microwave ovens leak a certain amount of microwave energy as well? If they don't, then why is my phone vibrator going off every time I come within 1m of a working microwave oven?

Owen Middleton  
Liverpool, NSW.

*It sounds as if the vibrator is responding to the weak 2.4GHz leakage from the microwave ovens, Owen, as well as to the cellular phone. Cellphones operate at UHF, in the 800 - 900MHz region, but the vibrator probably responds to the audio 'ringing bleeps'. ♦*

Letters published in this column express the opinions of the correspondents concerned, and do not necessarily reflect the opinions or policies of the staff or publisher of Electronics Australia. We welcome contributions to this column, but reserve the right to edit letters which are very long or potentially defamatory.

## EDITORIAL VIEWPOINT



### **Alternative electrotherapies: wading through the avalanche...**

There's certainly been a very 'healthy' response to the Forum article in the January issue, about what we might call 'alternative electrotherapy' devices — electronics-based units claimed to cure all manner of ailments, generally in a manner not accepted by current mainstream medicine. The response has been larger than I can recall us ever getting for a Forum topic, and to the point where I've been almost buried in letters, faxes and e-mail messages. (That's just from the January column, too — I get the feeling that there'll be another avalanche as soon as the same and/or other people digest February's column, just published as I write this!)

I confess I was a little surprised to discover that 'anti' letters far outnumbered those supporting our attempt to expose some rather dubious devices and marketing practices. In fact most of the responses came from people who were disappointed, upset or even downright angry that I had been in any way critical of these devices or dared to question the motives of those selling them. I've been accused of laziness, stupidity, blind ignorance, having a closed mind and/or being corrupt and on the payroll of the large multi-national drug companies...

It was also interesting to note just how many of the people who expressed themselves most upset about our supposed 'closed mind' treatment of alternative electrotherapy, at the same time didn't themselves hesitate to express criticism, ridicule, scorn and even outright hatred of conventional medicine, its practitioners and treatments. In fact with some of the writers there seemed to be an almost religious conviction that *everything* to do with conventional scientific medicine was totally bad, while conversely everything to do with alternative therapies was by its very nature good, and beyond criticism.

Anyway, I'm grateful that quite a few of the writers, even though they professed themselves angry with me and/or convinced that I have a closed mind, nevertheless also sent me information on the alternative therapy technologies they were defending/espousing. Some enclosed copies of literature, audio cassettes of lectures and talks, references to relevant information on the Web, and so on. One even sent a copy of a videotaped lecture, apologising for the poor video quality because it had been converted from NTSC.

Whether those people believe it or not, I am indeed studying and following up on this material, as quickly as time allows — because I *do* want to get as balanced and objective an understanding of these controversial topics as possible, in order to help our readers achieve the same end. It's in nobody's interests, in the long run, to dismiss *any* technology that may provide real benefits in treating human suffering; but by the same token, the unscrupulous use of electronics to dupe and fleece ill and desperate people should also be exposed, in the public interest.

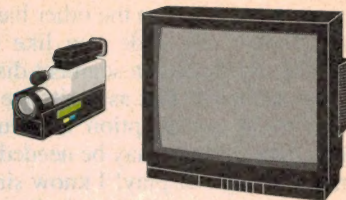
Wading through the unexpected avalanche of information may take a while, but rest assured we will return to this topic as soon as we can.

**Jim Rowe**



# WHAT'S NEW

IN THE EVER-CHANGING WORLD OF ELECTRONICS



## Electric 'neighbourhood vehicle'

Released at the recent International Electric Vehicle Symposium in Florida, the new Bombardier NV is being promoted as 'the world's first mass produced electric neighbourhood vehicle'.

It's designed for low-speed use in planned/suburban communities, or on the golf course or country club. It's manufactured by the Motorised Consumer Products Group, based in Montreal, Canada. (BusinessWire)



## Protects fax machines from zaps

FAXMAX 2, the US-made unit which protects fax machines against power surges and spikes, including lightning, is now available in Australia from Panamax. It plugs directly into the wall and has a catastrophic surge circuit which shuts off power automatically, thus preventing damage from massive surges, including lightning.

In the event of extended overvoltage, a thermal fuse shuts off power to connected equipment, preventing damage. The unit has an initial clamping level of 200 volts and a maximum current rating of 15A (1800W). Response time is instantaneous; energy dissipation is listed at 576 joules. EMI/RFI noise filtration is 50dB (99.7%) from 100kHz to 1MHz.

FAXMAX 2 features a 'Ground OK' diagnostic light, two AC receptacles, two modular phone jacks (RJ-11/45 compatible, pins 4 and 5 protected) and a seven-foot phone lead.

For more information circle 141 or contact Panamax distributors Eltek Pacific on (02) 9810-9060.



## Lowther speakers now available here

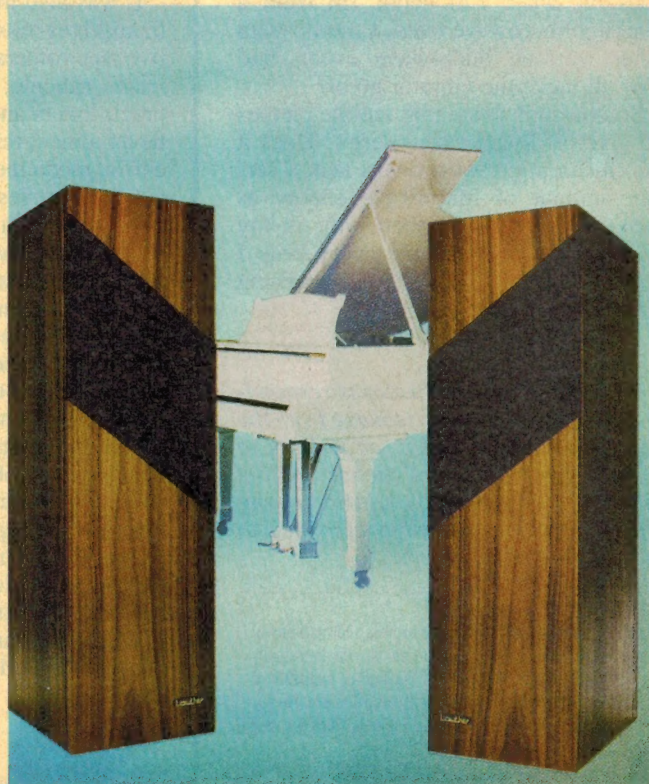
The loudspeaker drivers and systems made by famous British firm Lowther Voight Ltd are now available in Australia, including the Fidelio and Academy systems using Lowther's proven acoustic horn principle.

The company's new DX drive unit is also available, incorporating Lowther's advanced Rare Earth magnet technology and patented 'Hi-Ferric' magnet system, claimed to be equal in magnetic power to conventional permanent magnets of 10 times the size. The high magnetic power available allows for a substantial improvement in the damping effect on the speech coil, claimed to give a much clearer and cleaner signal than is currently available with conven-

tional magnet system. Due to the extremely small dimensions of the high powered magnet system there are also virtually no sound wave cancellations between the magnet's surfaces and the rear of the diaphragm.

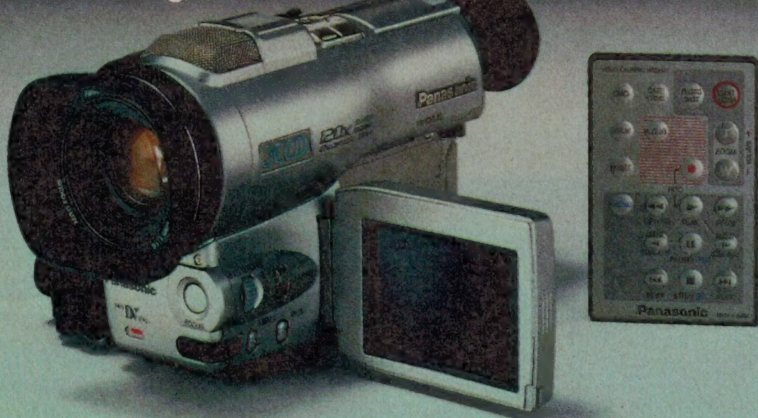
There are two DX models available, the DX2 with a flux density of 1.7 tesla and the DX3 with 2.0 tesla. Both have an overall diameter of 232mm and a depth of 70mm, with a 39mm diameter voice coil and a power rating of 100W. The nominal air resonance is 36Hz, and the rated frequency response is 30Hz - 20kHz for the DX2, and 30Hz - 22kHz for the DX3.

For more information circle 144 on the reader service card or contact Australian Electric Valve Importers, Unit 2, 22 Michellian Court, Bayswater 3153.





## 'Pro level' digital video camera



Panasonic's new flagship digital video camera (NV-DX100ENA) has a double density three-CCD image sensor, is lighter and smaller than its predecessor and includes a 63.5mm (2.5") LCD monitor and colour viewfinder. The DV (Digital Video) system provides 500-line horizontal resolution, which far exceeds the 400-line resolution of Super VHS or Hi8. It also assures colour

fidelity and includes an error correction function that minimises dropout and assures recording and playback quality and reliability.

Like a professional video camera, the NV-DX100 uses three separate 1/4-inch CCDs with 320,000 pixels for red, green and blue to optimise picture quality. Each of the 320,000 pixels on the three CCD chips has a large light-collecting area

which achieves high signal-to-noise ratio, high sensitivity and wide dynamic range without sacrificing resolution. The camera also has a bright F/1.6 lens, allowing shooting under visible minimum lowlight conditions down to 5 Lux.

The 63.5mm active matrix colour LCD monitor has a resolution of 180,000 pixels and is hinged so it will rotate freely over a 270° range. There's also a 12.7mm (0.5") high resolution (166,000 pixels) colour viewfinder, which can be tilted upwards by approximately 90° to the desired angle for shooting.

The NV-DX100 is equipped with a DV In/Out (IEEE 1394 Firewire) terminal so video and audio content can be fed in or out as digital signals without any data loss or corruption. It has an optical 12X zoom range with a digital zoom up to 120X, a digital image stabiliser and includes several creative digital functions including wipe, mix, gain-up, strobe, black & white and still.

The NV-DX100ENA is available from leading electrical retailers and specialist outlets for an RRP of \$5599.

## New Olympus digital SLRs have 3X zoom lens

The new Olympus Camedia C-1400L and C-1000L digital cameras combine high resolution with light weight, a built-in 3X zoom lens, intelligent flash, and TTL (through the lens) SLR type viewfinder. Their innovative and ergonomic design was inspired by the popular, award-winning Olympus IS series of 35mm SLR cameras.

The C-1400L features a 2/3" 1.4 million pixel (gross) progressive scan CCD delivering a maximum 1280 x 1024 pixel resolution, while the C-1000L uses a 1/2" 850,000 pixel (gross) progressive scan CCD delivering a maximum 1024 x 768 pixel resolution.

Features common to both models are an



all-glass aspherical f/2.8 autofocus zoom lens; the use of SmartMedia removable memory cards; a 45mm rear panel TFT colour LCD for reviewing images; three levels of compression; a serial port for connection to computer plus a high-speed parallel port for direct connection to an Olympus P-300 printer; and a variable power auto flash with red-eye reduction, fill flash, and flash-off modes.

The cameras come with a connection kit for Windows PC (3.1/95/NT4.0) and Macintosh, including Camedia utility software, TWAIN driver and Kai's PhotoSoap imaging software.

Available from photographic, computer, and duty free stores. Approximate RRP levels are \$2499 for the C-1400L and \$1999 for the C-1000L.

## Second generation DVD player from Panasonic

Panasonic Australia has launched what it says is a second generation DVD player, the DVD-A350. The player has a built-in 5.1-channel surround decoder for both MPEG2 and Dolby Digital (also known as AC-3). It is also backwards compatible with Dolby Surround, so people who currently have Dolby Prologic receivers and systems will get excellent audio output from DVD.

The DVD-A350 includes a newly-developed LSI chip which consolidates six functions including de-scramble, MPEG2 video decoder, video DAC, NTSC/PAL encoder, on-screen display and Dolby Digital surround decoding. Video signal processing is performed at 10-bit precision rather than the conventional 9-bits, which maximises the picture quality.

The player also has smoother scan and slow motion functions. First generation models showed a snap-shot effect when in fast-forward or rewind, but the DVD-A350 has a seamless picture when in these modes.

The DVD-A350 can also play back audio CDs and Video CDs. It carries an RRP of \$1699 and is available from leading electrical retailers.





## Flexible car audio system

Pioneer's new FH-P750 is a four channel, 40W per channel CD/cassette receiver with a built-in graphic equalizer, DSP, and many of the superior features found in Pioneer's top audio components. It also incorporates Pioneer's IP-BUS technology to facilitate communication to CD multi-players and other IP-BUS compatible products.

The inbuilt CD player uses Pioneer's Legato Link Conversion technology, which maintains the natural harmonics of music to beyond 20kHz. The cassette player provides Dolby B Noise Reduction, plus dual-groove SHC heads coupled to a Frequency Level Expander (FLEX) which automatically adjusts the power spectrum of pre-recorded music to enhance high frequency sound.

Pioneer's advanced Sound Field Control (SFC) combined with Digital Signal Processing (DSP) technology gives six modes to select from, and allows recreating

the ambience of studio, jazz club, stadium, concert hall and more.

The FH-P750 has an RRP of \$1999 and is covered by a 12-month parts and labour

warranty. For more information circle 142 on the reader service card or contact Pioneer Electronics Australia at 178-184 Boundary Road, Braeside 3195.



## Home theatre sound systems



The drama of *Jurassic Park* and other blockbuster movies is all around you with Dolby Pro-Logic Surround Sound and 5-D Theatre technology, with Pioneer's latest Syscom 3016 and 2016 component audio/video Home Theatre systems.

Pioneer's 5-D Theatre technology is said to enhance the Dolby Surround Sound tracks, making the sound 'more realistic' by applying some of the front-channel directional information to the rear surround channels.

Comprising 'dedicated' audio/video components, both the Syscom 3016 and 2016 systems represent what Pioneer considers to be outstanding, both in terms of sound quality and value for money.

The flagship Syscom 3016 system is based on the VSX-436 Pro-Logic receiver, which offers 65 + 65 watts in stereo mode or 60 watts from all five channels in surround sound mode. The Syscom 2016 system is based on the VXS-425 receiver, offering four channels of 40W RMS or 50 + 50W in stereo mode.

The Syscom 3016 (RRP \$2299) and Syscom 2016 (RRP \$1999) are covered by Pioneer's three year parts and labour warranty. For more information circle 145 on the reader service card or contact Pioneer Electronics Australia at 175-184 Boundary Road, Braeside 3195.

Valve amplification seem to be getting increasingly popular with pop music instrumentalists. British manufacturer Trace Elliot says that since the beginning of last year, there's been a dramatic increase in sales of its V-type 'all valve' bass rigs (like the V6 Bass Preamplifier seen here), and interest in the range has never been higher — especially among pros and semi-pros. It can't be the reassuring glow, because the valves are hidden inside!





## Panasonic releases a digital still camera

Panasonic has launched a compact digital still camera (Model NV-DCF1A), measuring only 93mm wide and 94mm high. It is VGA compatible, delivering 640 x 480-pixel resolution from a 350,000 square pixel CCD.

On the supplied 2MB memory card, it is possible to record 11 still pictures in fine mode, 23 in normal mode or 47 in economy mode. Up to 364 pictures can be recorded in economy mode using a 15MB commercially available memory card. For easy importing of image data into a computer, the card plugs into the computer's PCMCIA slot. The images can also be viewed on a TV set (with a PAL/NTSC tuner) by simply connecting the camera with the supplied cable.

To view the pictures being recorded, the NV-DCF1A has a 46mm (1.8") colour LCD monitor which can be tilted to a 40° angle.

PhotoEnhancer software and a TWAIN driver is included with the package for both Windows and Mac. This is loaded onto a personal computer and enables users to manage and edit (retouch) images.

Panasonic's NV-DCF1A is available from leading electrical retailers for an RRP of \$1099.



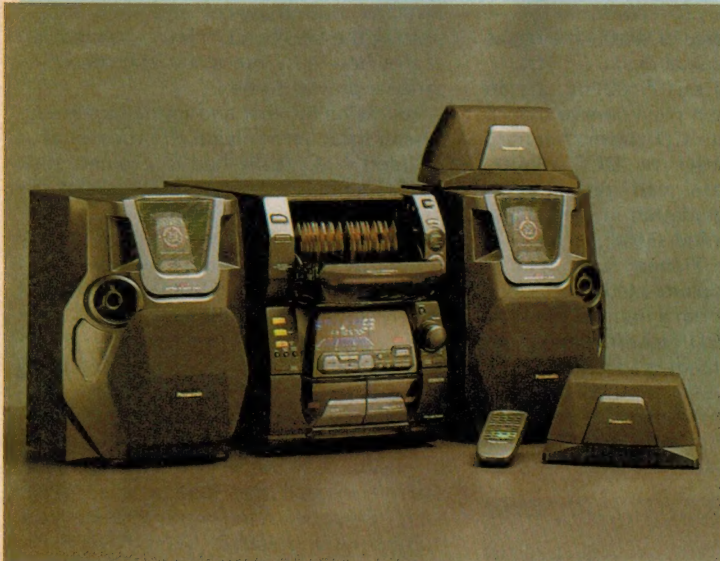
## High power mini hifi systems

Panasonic's new SC-AK90 and SC-AK70 'mini-fi' systems come complete with surround speakers and deliver high output power — 140W (RMS) per channel and 100W/channel respectively. The SC-AK90 also includes a built-in 170mm woofer.

A 13-band 'airport-like' spectrum analyser display included on both models provides an easy way to confirm play and operation status. There are six preset equaliser patterns (Disco, Hall, Live, Heavy, Clear, Soft) which allows users to select the sound most suitable to the sound source.

The two new systems have a 51-disc 'Jukebox' CD changer with Panasonic's 'Digital Servo' plus MASH 1-bit technology to ensure outstanding sound quality. Both systems also include dual cassette deck, AM/FM digital tuner, timer and a full function remote control.

The SC-AK90 and SC-AK70 have RRP's of \$1099 and \$879 respectively. For more information circle 143 the reader service card or contact Panasonic's Customer Care Centre on 132 600.



## Projector needs no PC

Mitsubishi Electric has launched a new video/data projector that is claimed to cure the 'presentation blues'. The LVP-X100A Multimedia Data/Video LCD Projector needs no companion PC to run computer-based presentations, because it has a built-in dedicated computer with PCMCIA (flash memory) card slot. Software is supplied to enable presentations to be downloaded onto a PC card which slips directly into the projector.

The projector produces bright, crisp XGA (1024 x 768 pixel) resolution images far superior to Super VGA resolution, and has a high brightness of 600 ANSI lumens. Electronically controlled zoom, focus and keystone correction ensure high presentation quality. The projector uses a 280W DC metal halide lamp and achieves a contrast ratio of 200:1, with image sizes from 51 to 762cm diagonal. It has built-in 2W stereo speakers.

The LVP-X100A projector measures 330 x 145 x 385mm (WHD) and weighs 9.8kg. It carries an RRP of \$12,995 plus tax.

For more information circle 140 on the reader service card or contact Mitsubishi Electric Australia, 348 Victoria Road, Rydalmere 2116. ♦





# PIONEER'S PDR-04 AUDIO CD RECORDER

Audio CD recorders have been available for a while, but until very recently they were far too expensive for most of us to even consider using them. That's now changed with the new Pioneer PDR-04, which Louis Challis has been trying out for this month's review. He discovered that it's an excellent CD player as well as a recorder — the ultimate toy for transferring your precious recordings over to compact disc!

Vinyl discs may well have reached the stage of being *passé*, but every second household still seems to have some lurking in a distant corner. Whilst many hi-fi buffs are loath to part with them, and their contents are not generally available on CD, there has been no easy or inexpensive way of transferring them to CD format.

But things have now changed. There is finally a cost-effective solution for that problem, in the form of Pioneer's new PDR-04 Compact Disc Recorder.

Now I must admit that when I was offered the chance to review the PDR-04 my response was an immediate 'Yes!'. I had previously reviewed one of the first commercial CD recorders, and although it was good, it was also expensive. By contrast, the PDR-04 is *comparatively* inexpensive. More significantly, it incorporates a number of practical exciting ergonomic features, designed to make your mouth water at the very thought of owning one.

One of its most endearing features is

that it is also an outstanding conventional CD player. It provides conventional stereo line outputs, supplemented by both optical and coaxial digital outputs. In addition, with its well written handbook to help, it's a delightfully simple CD recorder to use — offering you the choice of stereo analog, as well as optical or coaxial digital inputs.

Quite apart from this flexibility, it's an absolute breeze when you come to record directly from another CD player, Minidisc player, DAT recorder or DCC player. More critically you can do it with absolutely zero degradation in the quality of your newly recorded signal.

The designers at Pioneer have had at least four years, supplemented by copious feedback provided from a number of previous generations of CD recorders, to develop this into an outstanding CD recorder.

But I soon discovered that its most attractive feature is only apparent when you're recording from a digital source. By using its Automatic Digital Source

Synchronised recording mode, I was able to take one of my CD test discs and copy it simply by plugging in a digital coaxial lead, followed by the selection of the appropriate input (by pressing the 'Digital Synchro' button twice) and then simply starting the source CD player. I marvelled at just how easy the automatic recording process proved to be.

Following my first and immediately successful foray into 'digital CD recording', I decided that I really had to evaluate how well (and how easily) I could repeat the procedure with analog signals.

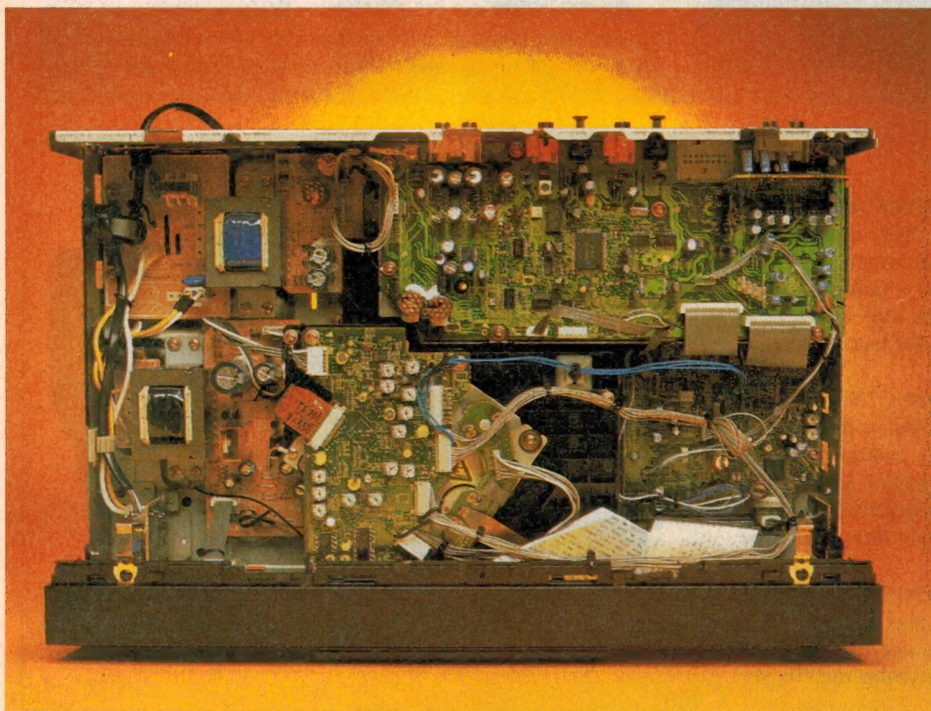
I decided to kill 'two birds with one stone', by taking the same test disc that I had just used for the 'digital synchro' test and recording the frequency sweep track again. That provided me with two nominally identical signals, but recorded using two different recording modes.

The only real difference was that, when recording with the analog input, one has to ensure that the peak recording signal doesn't exceed the '0dB system upper limit'. If you want to ensure that the track numbering sequentially also follows in the correct order, then you have to also press the 'Manual Write' button on the recorder's front panel. The PDR-04 then automatically (and correctly) numbers each successive track on the disc. When the source material does not already contain track information then you have to press the 'Manual Write' button between tracks to correctly encode the disc with track numbers.

With a test disc (or with software) which exhibits minimal variation in recording level, that task is dead easy. With more typical programme content and specifically where the difference between minimum or peak signals exceeds 35 to 50 decibels, then a little more care is required in adjusting the gain control potentiometers on the programme source.

The PDR-04 designers have provided an

***Inside the case there are no less than eight PC boards, interconnected via ribbon cables — some of them screened. One is directly above the laser head.***







**At 420 x 285 x 125mm it's not small, but the performance is excellent.**

added 'safety net' feature. When reviewing the programme source material before commencing final recording, the PDR-04 will automatically readjust its internal gain control amplifiers. In the event that a recording signal temporarily exceeds 0dB, the internal gain control amplifier will automatically limit the compression gain setting so as to avoid clipping the peaks. Conversely, if the recorded signal level is far too low, then this may be corrected by pressing the 'Skip Play' button following the 'Pause' button. The recording level gain control setting is then automatically adjusted up in level to provide improved signal to noise characteristics.

All of the control functions provided on the PDR-04's front panel are replicated on the unit's remote control. The most critical of the special controls is the 'Finalise' button. You might be intrigued by the concept of 'Record Finalisation', but remember that CD's, MiniDiscs, DVD and CD-ROM discs all have a 'Table of Contents' (TOC). No disc is complete or functional without a TOC, so you have to encode that TOC data before the disc is useable. Fortunately the complex encoding process is automatically executed on the PDR-04 simply by pressing the 'Finalise' button.

### Lab tests

I 'finalised' the two test discs that I had recorded and took them into the laboratory to measure their most important objective performance parameters. I started with the two swept frequency responses — the first recorded digitally and automatically, and the second recorded using the more conventional analog inputs.

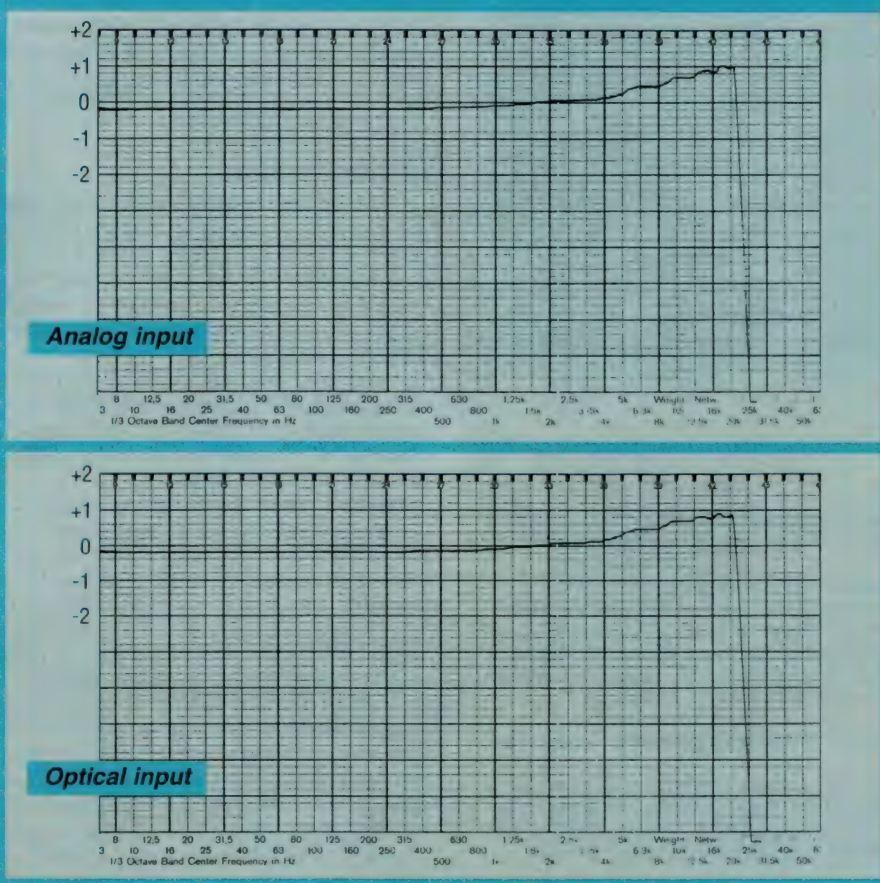
The results of the two recorded frequency response graphs proved to be far flatter than I would have expected. The output is ruler flat from 5Hz to 500Hz, with the digital-input recording showing a slow and

gentle rise up to +0.8dB at 20kHz. With the analog inputs the rise is only a further 0.2dB more — i.e., +1dB overall rise at 20kHz (see graphs). That 1dB rise in the frequency response for signals covering a 20kHz bandwidth is outstanding.

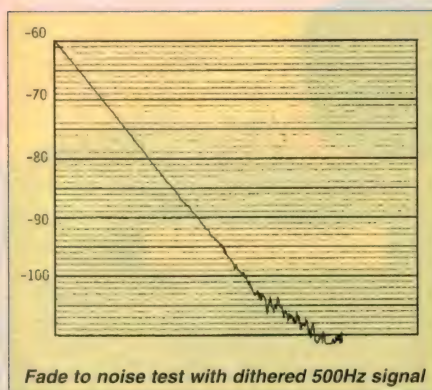
The next test evaluation was with a pre-

recorded 'fade to noise' test track. Here I was positively astounded by the results. The response was ruler flat from -60dB to -90dB, and was still remarkably good at -100dB. For signals below -100dB the residual noise on the test disc (or within the recorder) dominated the shape of the

**PIONEER PDR-04 — Record to replay frequency response**







On the back panel there are analog, digital and optical inputs as well as outputs.



## MEASURED PERFORMANCE: Pioneer PDR-04 CD Recorder

Serial No. RHNN00987044

### 1. Record to Replay Frequency response

Digital Inputs	5Hz to 20kHz
	+0.8dB/-0dB
Analog Inputs	5Hz to 20kHz
	+1.0dB/-0dB

### 2. Replay Linearity

Nominal Level	Measured Output	
	L dB	R dB
Undithered Signal:		
0dB	0.0	0.0
-1.0	-1.0	-1.0
-3.0	-3.0	-3.0
-6.0	-6.0	-6.0
-10.0	-10.0	-10.0
-20.0	-20.0	-20.0
-30.0	-30.0	-30.0
-40.0	-40.0	-40.0
-50.0	-50.0	-50.0
-60.0	-59.9	-60.0
-70.0	-70.0	-70.0
-80.59	-80.5	-80.5
-85.24	-85.2	-85.2
-89.46	-89.3	-89.4
-91.24	-91.0	-91.1
Dithered Signal:		
-80.7	-80.7	-80.7
-90.31	-90.1	-90.2

(see fade to noise test)

### 3. Frequency Accuracy

19.999kHz signal: Output 19.995kHz

curve and provided a conventional curvature in the response.

To make sure that I wasn't fooling myself, I used two additional objective test discs to carry out a more comprehensive evaluation. The results confirmed that the PDR-04 delivers a truly exceptional linearity. The linearity at -90dB in particular is outstanding. When using dithered test signals the performance equals the best that I have yet seen.

I had a quick look at the recorder's distortion figures, which were good but not exceptional. By contrast the signal to noise figures were very good at 100dB(A) and somewhat better than claimed. The frequency accuracy was also quite good at -0.02%, although that's not really exceptional these days. All other parameters and functional characters that I evaluated were well within specification, and frankly couldn't be faulted.

## Inside the box

I opened the recorder's cabinet, as I was intrigued to see just what Pioneer had put inside. I discovered eight printed circuit boards inside, most of which are interconnected by means of conventional ribbon cables, or more interestingly, with some fully screened ribbon cables. Pioneer's circuit designers have clearly taken considerable trouble to effectively screen each separate module, and have also used supplementary HF filtering with toroidal chokes on some internal feed lines.

Whilst I noted the presence of numerous proprietary (Pioneer) large scale integrated circuits, I was much more interested in the unusual recording/reading laser assembly. This has a very large printed circuit board directly on top of the laser heads, which are integrated into a rigid and complex moulded plastic assembly. The designers have opted for a sensible reversal of the recordable or prerecorded CD format. This places the laser on top of the disc, instead of under it. This ensures that the laser's lens assembly points down, thereby ensuring a dust-free lens surface — which conventional laser assemblies never seem to be able to maintain.

## Listening tests

Following my foray into the cabinet, I took the PDR-04 home for an in-depth evaluation assisted by my test panel. I wanted to see if they could tell the difference between an original and a copied CD. Crazy you say? Well yes, it may be; but some of them initially claimed they could hear — and more importantly, tell the difference.

Now I had been given two 'TDK' blank recordable CDs and two Pioneer blank recordable CDs, all clearly labelled with the words 'For music use only'. I also had a box of CD-R recordable CDs, which I assumed were the same. The recorder quickly told me I had made a mistake. It flashed up the warning 'CD PRO', which the manual then informed me meant that this was a disc that wouldn't be accepted.

With conventional CD-Rs selling at under \$5 in boxes of 10 and the compatible CDs selling for typically \$14 - 16, the cost of recording your own CDs is still a significant factor to be considered in terms of disposable expenditure. Presumably the price difference is intended to provide funds back to the owners of the software, but I can't fathom how this will actually work...

I recorded excerpts from three new Telarc discs featuring Sir Charles Mackerras conducting the Scottish Chamber Orchestra, playing Brahms' Symphonies numbers 1 to 4 (Telarc CD-80463-64-65). These are fabulous discs, with rich superlative sound and exquisite music.

When I found I had two listeners who claimed that they could 'hear a difference' between the original and the copy, I was concerned! However resorting to a series of 'double blind' tests soon put that issue behind us, as I found they couldn't really pick the difference!

I spent the next three weeks of pleasant listening using the PDR-04 to play music during my Christmas vacation. I found that this is not just an amazing CD recorder, but also an exceptional CD player. At a whisker under \$2000, it's simply the best possible toy to buy when you want to record your own music on disc, or want to re-record your old (or new) discs for posterity. ♦

## Pioneer PDR-04 CD Recorder

A domestic recorder for audio compact discs, measuring 420 x 285 x 125mm.


**Good points:** Excellent frequency response and signal-to-noise performance, both as a recorder and as a CD player. Provides analog, digital and optical inputs, also the same choice of outputs. Source synchronising allows very simple recording from digital sources.

**Bad points:** Won't record on CD-R blanks, increasing the cost of recording.

**RRP:** \$1999

**Available:** Pioneer stockists. For details contact Pioneer Electronics Australia, 178-184 Boundary Road, Braeside 3195; phone (03) 9586 6300 or fax (03) 9587 1495.





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# CANON'S MV-1 DIGITAL CAMCORDER

Two mighty forces in imaging now seem to be tackling each other head-on: the traditional photographic industry and the video camcorder makers. Both have the same origins, and are being forced to join the digital multimedia revolution. The outcome is likely to be some exciting new consumer imaging products, judging from the Canon MV-1.

by BARRIE SMITH



As with many modern camcorders and cameras, there's both a turret-type viewfinder and a swing-up colour LCD screen. Canon wisely only boosts the 14:1 zoom lens by a further 2.5X digital zoom facility.

The year 1996 saw consumer-level digital still cameras arrive on the market — with barely adequate performance, but attractive prices. Digital video camcorders also saw the light of the market around the same time — with elevated performance and prices.

As digital still cameras began to proliferate, some began to offer restricted motion capture — and sound. Soon after, video-based companies foresaw that provision of single-frame capture modes in *their* video camcorders would also be a market plus. So we now have the situation of a number of hybrid cameras on sale, able to offer a little bit of both — stills *and* movies.

The cameras may share capabilities, but the interesting thing at this stage is that there is a standoff in terms of the storage medium. The still cameras almost entirely rely on flash cards (although the Sony Mavica uses a floppy) to supply the storage memory. This gives one great benefit: simple and rapid access to individual frames. But also one great turnoff: full motion and stereo sound demand enormous amounts of memory.

Meanwhile, the digital video camcorders employ the newish 6.35mm-wide DV magnetic tape, capable of near-broadcast video quality. But this brings two obvious penalties if the unit is used for single-frame capture: searching for a single frame on a 60-minute tape (holding a potential 90,000 images!) is a serious obstacle, and the highest quality possible is currently only 640 x 480 pixels (VGA).

Camcorder manufacturers must have rejoiced when they found the new breed of digital camcorders could, in fact and truth, be justifiably described as 'multi-media' cameras. A camcorder such as Canon's new digital MV-1 unit is capable of capturing full motion video and 16-bit stereo sound that could be



**Using the optional DK-1 kit, images can be transferred between the MV-1 camera and a PC — both ways.**

dubbed, edited and manipulated across multiple generations with minimal quality loss to provide material for TV commercials, news etc. — as well as deliver individual still frames to a computer, able to be manipulated by such applications as Photoshop and then either turned into colour hard copy or used as an element in a Web page.

## Image overlay

The MV-1 is Canon's first DV camcorder. The company has somewhat of an elevated image in terms of traditional silver halide photography, which it has endeavoured to overlay onto its video products.

Back in 1991 the EX1 camcorder using analog Hi8 tape offered an interchangeable lens facility. The result was a camera applauded not only by well-versed amateurs, but also by pros.

Unfortunately the EX1 was a heavy and bulky blighter, a burden not eased when a heavy 1000mm tele lens was attached — yes, it could accept 35mm SLR lenses!

Now it seems the company is treading down the same path with its new line of DV camcorders. The new unit is close to an SLR lookalike: big lens out front, handgrip at the side and weight tipping towards a kilo. Close one eye and you think you're holding an SLR — and while your eye is closed, don't forget to hold the MV-1 with two hands!

A follow up model — the XL-1 — will apparently offer interchangeable lenses.

## Excellent specs

You have to admit, video makers have it rich these days. The MV-1 offers a bounty of features and options.

For the first time in a camcorder, the CCD can record in progressive scan as well as interlaced mode — so in terms of single frame capture it acts as a motor drive, up to 25f/s. The progres-



sive scan CCD is complemented by an RGB primary colour filter, rather than the complementary CMYK colour filter found in other camcorders. Canon claims that the combination of this and the progressive scan CCD achieves

## Specifications

**Video recording system:** two rotary heads, helical scanning system.

**DV system:** Consumer digital VCR SD system.

**Audio recording system:** PCM digital sound; 16 bit (48kHz/2ch), 12 bit (32kHz/4ch).

**Image sensor:** 1/3 inch progressive scan CCD, 450,000 pixels (420,000 effective pixels).

**Tape speed:** SP 318.83 mm/s; LP 12.57 mm/s.

**Lens:** f/1.8-3.2, 14X power zoom, 5.2-72.8mm.

**Dimensions:** 138 x 106 x 133mm (WxHxD).

**Weight:** 930g

colour resolution comparable to that of three-CCD systems.

In Photo mode owners may record in full auto mode, so the camera will set

exposure and shutter speed automatically, or use the Program AE dial to make manual selections. Each digital still captured is recorded to tape for approximately six seconds, along with sound capture. Photo mode also allows consumers to use a Canon Speedlite flash relying on through-the-lens metering. A focus assist beam and pre-flash enables the camera to set focus, exposure and white balance; flash synchronises with shutter speeds from 1/60 to 1/1000 of a second.

The zoom lens has a 14X optical/35X digital range with optical image stabilisation. The latter, unlike electronic versions, employs a unique Vari-Angle Prism (VAP) technology which optically compensates for camera shake, with no image degradation.

Manual control is generous, as well as Program AE modes including spotlight, sand and snow and negative. The latter will be useful for those who wish to shoot still film frames, using a dedicated FP-100 film adapter. There are four digital scene transitions: vertical wipe, window wipe, fade trigger, and mosaic fade.

## No copy right

Some DV camcorders have appeared on our market offering digital input, but no return input path. The Canon model offers a two-way digital path.

The MV-1 also allows analog composite video and sound outputs as well as the component S-video format — useful for

dubbing to VHS VCR decks.

However, the MV-1 does not have an analog input. As Canon gravely declares 'The reason is copyright. If you could copy to DVC, then you would be able to make any number of perfect digital copies from the copy, which has the potential for copyright violation'. Shock, horror!

So, again we are prevented from enjoying

the full benefits of a major new technology. Whilst there are undoubtedly some shady characters out there ready to make pirate copies of commercial titles, spare a thought for the keen amateur holding a library of analog tapes accumulated over the years.

Fancy letting the consumer make perfect copies of his own analog tapes!



**SP/LP Recording:** users can extend recording time by 1.5 times by selecting LP (Long Play) mode. In addition to a built-in colour viewfinder, the external 5.1cm LCD screen can be angled 110° fore and aft.

**Other modes:** 16:9 wide screen for video playback on a wide screen TV; Date Code records date, time, shutter speed and exposure settings — the information remains hidden until selected for display; Time Code identifies each recording in hour, minute/second/frames.

## In the hand

The camcorder is not large, just bulky — and at a kilo, fairly heavy. Appreciated is the external 51mm colour LCD viewing screen, mounted on the camera's top surface. Beside it is a conventional viewing turret, housing a light shielded 14mm colour LCD screen. A flash hot-shoe sits astride the finder, further evidence of the MV-1's ability to accept a still camera flash gun.

Dominating the camera's front is the 49mm diameter zoom lens. A 14X optical power being *de rigueur* these days, Canon wisely augmented it by adding a modest digital boost, which goes only to 35X (2.5X the 14X optical power). Most viewers will accept a picture shot with 2X digital enlargement of the CCD's information — but no further.

Some quibbles could be levelled at the placement and quality of the stereo microphone, concealed and encircling the lens' top curve. Surely a \$4000-plus camera could justify a mike worthy of the device's digital image quality. But at least there's provision for an external mike and monitoring headphones...

Still photographers will relish the exposure control. In Tv mode (shutter priority) you can dial in any shutter speed available, from the maximum 1/2000 right down to 1/6 sec; this means you can shoot a computer screen monitor with virtually no roll bars. In Av (aperture priority) mode the lens aperture can be varied in single-stop increments (should have been half stop!) from wide open at f/1.8 down to f/32. There did not appear to be any provision for video gain adjustment.

## Image, sound quality

On test, the DV format of the MV-1 delivered stunning images with excellent definition and no sign of colour fringing. Sound quality was similarly

## Still capture

The Canon MV-1 has a DV input and output, so it is well configured from the outset to capture, deliver — and even accept — still frames to and from a PC, at 640x480 pixel resolution.

To accomplish this a DV Capture Kit DK-1 is available: a software application called Canon DV Commander, a TWAIN driver (to interface with imaging applications), an Adaptec 8940DV capture board and an IEEE1394 DV (which links camcorder and PC). As well, a full version of MGI Photosuite 8.05 is supplied. No Macintosh interface is available. Once hooked up, the Commander software creates a VCR-like control panel on the PC monitor. You search for individual frames on tape, download them in the required format (PICT, JPEG, TIFF, BMP), adjust colour and



contrast or even 'de-interlace' any paired fields not shot in progressive scan mode.

At a demonstration at Canon's North Ryde office, I was highly impressed by a series of still-frame family snapshots captured by exec John Garforth with the MV-1 and displayed on a large PC monitor. A final printout onto inkjet confirmed the quality of the camera's still capture mode.

The cost of the DK-1 kit is around \$900.

crisp and noise free — except for a little buzzing when the zoom was driven.

Progressive scan seems to be a natural choice for shooting still frames, but canny operators will soon become aware of strobing in pans, tilts, zoom and fast moving action. 'Ye olde' interlaced scanning may be yesterday's technology, but it still reproduces smooth movement on video, thanks to its 50 field per second rate.

Summarising, the Canon MV-1 is a superb piece of engineering and design. A little heavy, but well featured. For those who want full quality digital video and audio capture along with the benefits of single frame capture, this will please many fastidious users. ♦

## Canon MV-1 Digital Camcorder

Enhanced domestic-level video camcorder using digital video (DV) technology.

**Good points:** Excellent digital image and sound quality, choice of interlaced or progressive scanning. High quality still images; high degree of manual control possible.

**Bad points:** A little heavy; internal microphone picks up zoom lens noise.

**RRP:** \$4399

**Available:** Canon camera dealers, or contact Canon Australia, PO Box 313, North Ryde 2113; phone (02) 9805 2000.



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READER INFO NO.4





# ULTRASONICS TAKES THE GRIND OUT OF MAKING FERROFLUIDS

Ferrofluids have been used for many years — they're used to improve the performance and power handling capacity of many hifi speakers, for example. Traditionally they're made using a tedious ball milling process, but now researchers in the USA have discovered a better way: using 'sonochemistry', where a chemical reaction is triggered by high powered ultrasonic energy.

by GEOFF McNAMARA

Making ferrofluids can be a real grind. Ferrofluids are colloidal suspensions of microscopic permanent magnets that have been used in industry for about a quarter of a century. They have applications ranging from permanent seals around rotating shafts to medical imaging and improving the performance of your stereo's speakers. Future uses may extend to ink for high-speed printers and as fluids in your car's clutch and brake lines.

But as Kenneth Suslick, Professor of Chemistry at the University of Illinois at Urbana-Champaign points out, "The current way of making ferrofluids commercially is amazingly painful: magnetite is ballmilled in surfactant/solvent mixtures for weeks on end."

Suslick and his team have found a better way. Using a new technique called 'sonochemistry', Suslick uses ultrasonic waves to create the conditions where metal compounds are altered at the molecular level. "By comparison with the old method of making ferrofluids, our new sonochemical synthesis technique is both simple and quick."

Making ferrofluids using sonochemistry is based on changing the molecular structure of metals using ultrasound. Ultrasound has frequencies ranging from around 15kHz to tens of megahertz, corresponding to wavelengths in liquids ranging from centimetres down to microns. Sonochemistry involves passing ultrasonic waves through a liquid containing whatever it is you want to work with, in this case iron pentacarbonyl.

The molecular changes that occur aren't a result of the action of sound waves on molecules themselves, but rather they come about because of a process called 'cavitation'. Since ultrasound consists of alternating compression and expansion waves, as the ultrasound passes through the liquid the alternating compression and expansion waves push and pull on the liquid.

A loud enough expansion wave can literally pull the liquid apart to create a cav-



*A scanning electron micrograph of nanostructured iron, obtained on an Hitachi S-800 electron microscope. The powder is agglomerates of 20nm particles. (Kenneth Suslick, University of Illinois at Urbana-Champaign)*

ity — that is, a bubble — which is then compressed by the following compression wave, followed by another expansion wave, and so on. All this is happening at perhaps 20,000 times a second.

The tendency is for the expansion and compression waves to cancel out. However, owing to a number of mecha-

nisms, the expansion is slightly greater than the compression and so the bubble not only remains, it grows. So long as the bubble is of a size that it is in resonance with the sound waves it can absorb energy and continue to grow. It soon becomes so large, however, that it is no longer well coupled to the sound waves. By the time it



reaches a few hundred microns it implodes violently.

## Hot spots

This collapse is what facilitates the molecular changes. As the bubble collapses, the gas within the bubble is heated by compression. A shock wave generated within the bubble heats the gas still further. Since the implosion occurs so quickly — over a period probably considerably less than 100 nanoseconds — the heat has no time to escape into the surrounding liquid. The result is a hot spot within the bubble with some spectacular characteristics.

For one thing, the hot spot is estimated to be above 5000K (about the same as the surface of the Sun) and a pressure of 1700 atmospheres (what you'd find at the bottom of the ocean). All of this happens with the speed of a lightning strike!

The fall in temperature of the hot spot corresponds to a cooling rate of 1010 degrees per second. To put this into perspective, if a red-hot poker were thrust into ice water the cooling rate would be a few thousand degrees per second; molten metal spattered onto a surface cooled with liquid nitrogen would cool at a few million degrees per second.

## Not the aim

Suslick and his colleagues didn't set out to develop a new way of creating ferrofluids, however. In fact, once they'd developed the technique, they then looked at what it could be used for. One of the possibilities they considered was creating amorphous metals — metals without any crystalline structure. Such metals have unusual magnetic, electronic and catalytic properties.

In order for a metal to become amorphous, it has to cool quickly enough so that it freezes before it has time to crystallise. Since the required cooling rates to make amorphous iron are on the order of a million degrees per second, the process has been difficult. Suslick points out that the enormous cooling rates within the collapsing cavities is more than fast enough to create amorphous iron.

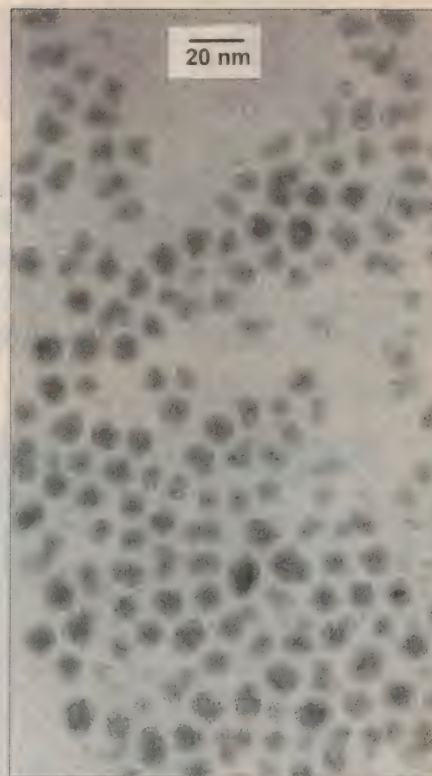
It's the collapse of the cavities and creation of the hot spots that do the molecular rearranging. But how do you get the metal atoms inside the tiny cavity? The scientists got around this problem by using metal-containing compounds. When ultrasonic waves are radiated through the iron pentacarbonyl solution, the iron pentacarbonyl decomposes into iron atoms within the cavities. These atoms then combine into clusters of a few hundred atoms about two ten-millionths of a centimetre in diameter.

**A transmission electron micrograph of sonochemically prepared iron colloid particles (average particle size 8nm) stabilised by oleic acid. (Kenneth Suslick, University of Illinois at Urbana-Champaign)**

These clusters form a fine, highly reactive black iron powder. Since this powder burns spontaneously in air, the clusters have to be treated. "If we coat these particles, stable iron colloids are formed in which the metal particles stay suspended indefinitely — ferrofluids", said Suslick.

So far, the researchers have concentrated on small-scale experiments. "We use a high-intensity ultrasonic horn that consists of a solid titanium rod connected to a piezoelectric ceramic and a 20kHz, 500V power supply," Suslick explained.

Although this is too small to produce industrial quantities, Suslick points out that large scale commercial equipment is already available. "Though we haven't actually tested these systems to see if they can produce ferrofluids", Suslick said. He also points out that "probably a NAP reactor (Near-field Acoustic Processor) could be used — these are commercially available here in the United States. They have been used to treat ore and coal mine



tailings at 20 tons per hour."

*Geoff McNamara is a freelance science writer based in Sydney. ♦*

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# NEAR: NOW IT'S GOING FAR...

NASA's NEAR spacecraft, launched in February 1996, flew past asteroid Mathilde in June 1997 and will be the first spacecraft ever to orbit an asteroid when it arrives at Eros in December 1998 — orbiting as close as 15km and sending back a huge amount of important data on asteroids before attempting a soft landing on Eros' surface during January 2000. Actually it's not designed to survive the landing, but stranger things have been known to happen...

by KATE DOOLAN



Part of NASA's low-cost Discovery program, the Near Earth Asteroid Rendezvous or NEAR spacecraft has been designed to have a four-year lifespan and to have the capability to operate at a distance of up to 330 million kilometres from the Sun.

The spacecraft structure is an eight-sided box constructed of 1.7m<sup>2</sup> of aluminium honeycomb panels connected to forward and aft aluminium honeycomb decks. Mounted on the outside of the forward deck is the X-band high-gain antenna, the four solar panels and the X-ray solar monitoring system. Most of the spacecraft's electronics are mounted on the inside of the forward and aft decks, while all but one of the scientific instruments are fixed in position on the outside of the aft deck. The magnetometer is mounted on the high-gain antenna feed. A star camera points out to the side of the spacecraft away from the instruments, so that a star-filled view is available during asteroid operations. The interior of the spacecraft contains the propellant module.

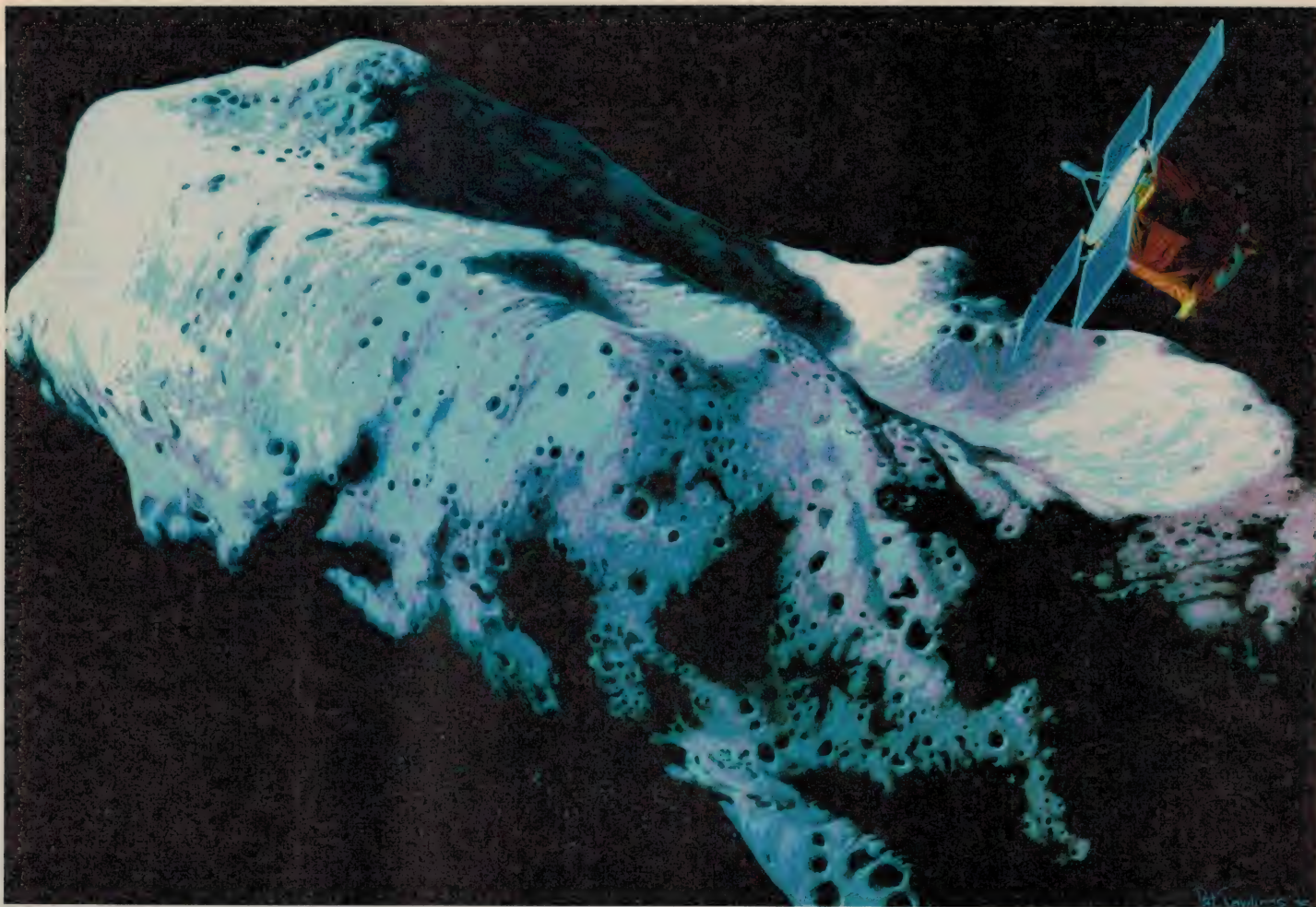
The spacecraft's power system consists of four 1.8 x 1.2m gallium arsenide solar panels, a super nickel cadmium (NiCad) battery and power system electronics. The solar array produces 400 watts of power at NEAR's maximum distance from the Sun (330 million km) and 1800 watts at 150 million kilometres from the Sun.

The power provided by the solar arrays is a function of the spacecraft-Sun distance and the incident solar angle, which will have to remain at 30° or less during the rendezvous at Eros. The battery is a 9-amp hour, 22-cell super NiCad unit which provided power to the spacecraft prior to solar array deployment and during times when solar power is not available.

NEAR's telecommunications subsystem is an X-band system capable of transmitting telemetry data, receiving spacecraft commands and providing Doppler plus ranging tracking. In addition to the 1.5m high-gain

*The protective fairing being installed around the NEAR spacecraft and the third stage of its Delta II launch vehicle, at Cape Canaveral.*





antenna, there are two low-gain antennas plus a medium-gain antenna with a fan shaped radiation pattern. The ground stations of NASA's Deep Space Network (DSN) provide contact with the spacecraft.

Eight discrete downlink data rates are supported. In operation with the DSN's 34m high efficiency and beamguide antennas, the rates are 9.9bits/s (emergency mode), 39.4b/s, 1.1kb/s, 2.0kb/s, 4.4kb/s and 8.8kb/s. During critical operations, the DSN's 70m antennas can provide downlink rates of 17.6 and 26.5kb/s. The downlink hardware, which was developed by the Applied Physics Laboratory at the Johns Hopkins University in Laurel, Maryland uses a solid state power amplifier with an output level of 5W. The normal uplink data rate is 125b/s while the emergency mode uplink is 7.8b/s.

The command and handling subsystem consists of four major segments — two redundant command and telemetry processors, two redundant solid state recorders, a power switching unit to control spacecraft relays and an interface to two redundant 1553 standard data buses for communicating with other processor controlled subsystems. The functions provided are command management, telemetry management and

autonomous operations.

The solid state recorders are constructed from 16MB IBM-Luna C DRAMs. One recorder has 670MB of storage, while the other has 1.1GB capacity as it contains an additional memory board — which was designated as a flight spare to replace either of the memory boards in a ground test failure.

### Instrument payload

Despite the lower cost and rapid development schedule of the NEAR spacecraft, its instrument designs incorporate many technical innovations which include:

- First spaceflight of a silicon solid state detector viewing the Sun and measuring the solar input X-ray spectrum at high resolution
- First spaceflight of a bismuth germanate anti-coincidence shielded gamma ray detector
- First spaceflight of a laser incorporating an in-flight calibration system
- First spaceflight using a near-infrared system with a radiometric calibration target and an indium-gallium-arsenide focal plane array that does not require cooling with liquid nitrogen.

The Multispectral Imager (MSI) is a high-resolution visible-light camera that will

determine the overall size, shape and spin characteristics of Eros and will map the morphology and mineralogy of surface features. The imager will also be used for optical navigation at Eros and to search for satellites. Images taken during the approach, flyby and orbit of Eros will be able to detect features as small as three metres across.

Adapted by APL/JHU from a military remote sensing system, MSI is a 537 x 224 pixel CCD camera with a five element, radiation hardened refractive optics. The instrument covers the spectral range from 0.4 to 1.1µm. It has an eight-position filter wheel with filters chosen to optimise sensitivity to minerals expected to occur on Eros. The MSI has a field of view of 2.25 x 2.9° and a pixel resolution that corresponds to 9.5 by 16.1 metres viewed from 100km. The instrument has a maximum image rate of one per second, with images digitised to 12 bits.

The Near-Infrared Spectrograph (NIS) will measure the spectrum of sunlight reflected from Eros in the near-infrared range from 0.8 to 2.7µm, in 64 channels. NIS data will provide the main evidence for the distribution and abundance of surface minerals such as olivine and pyroxene. Together with the measurements of elemental composition from the X-Ray/Gamma Ray



## NEAR: NOW IT'S GOING FAR...

Spectrometer and colour imagery from the Multispectral Imager, NIS should be able to provide a link between asteroids and meteorites and clarify the processes by which asteroids evolved and formed.

Also adapted from a military remote sensing instrument, the NIS is a grating spectrometer that disperses light from the slit field-of-view across a pair of passively cooled, one dimensional array detectors. One detector is a germanium array covering the lower wavelengths from 0.8 to 1.5 $\mu$ m. The other detector is an indium-gallium-arsenide array covering 1.3 to 2.7 $\mu$ m. NIS also carries a diffuse gold calibration target that can reflect sunlight into the spectrograph and provide in-flight spectral calibration.

The X-Ray/Gamma Ray Spectrometer (XGRS) will measure and map abundances of several dozen key elements at the surface and near-surface of Eros. X-rays from the Sun striking the asteroid can produce significant count rates of fluorescence X-rays from low atomic number surface elements such as aluminium, magnesium and silicon. The elements sulphur, calcium, titanium and iron are also present in asteroids, but count rates are lower and data takes longer to accumulate. Similarly cosmic ray protons can interact with the asteroid surface to produce gamma rays characteristic of the nuclear energy levels of a given element. Gamma rays can also be spontaneously emitted by naturally occurring radioactive elements such as uranium, thorium and potassium.

The XGRS comprises two state of the art sensors: an X-ray spectrometer and a gamma ray spectrometer. The X-Ray Spectrometer is an X-ray resonance fluorescence spectrometer that detects the characteristic line emissions excited by solar X-rays from major elements in the asteroid's surface. XRS covers the energy range from 1 to 10keV (kilo electron volts), using three gas proportional counters. A balanced, differential filter technique is used to separate the closely spaced magnesium, aluminium and silicon lines below 2keV. The gas proportional counters directly resolve higher energy line emissions from iron and calcium.

The Gamma Ray Spectrometer (GRS) detects characteristic gamma rays in the 0.3 - 10MeV range, emitted from specific elements in the asteroid's surface. GRS uses a body mounted, passively cooled sodium iodine detector, enveloped by an active bismuth germanate anti-coincidence shield to provide a 45° field-of-view. Abundances of several important elements such as silicon, iron, and potassium will be measured in four quadrants of the asteroid.

The NEAR Laser Rangefinder (NLR) will determine the distance from the spacecraft to



**The NEAR spacecraft undergoing spin balance testing at NASA's Goddard Space Flight Center.**

Eros by precisely measuring the delay time between firing of a laser pulse and its return reflection from the surface. NLR uses a neodymium-doped yttrium-aluminium-garnet solid state laser and a compact reflecting telescope. It sends a small portion of each emitted laser pulse through an optical fibre of known length and into the receiver, providing a continuous in-flight calibration of the timing circuit.

The ranging data will be used to construct a global shaped model and a global topographic map of Eros with a horizontal resolution of 300m. The NLR will also measure detailed topographic profiles of surface features on Eros with a best spatial resolution of six metres.

The Magnetometer (MAG) is a three-axis fluxgate sensor mounted on a tripod bracket above the high-gain antenna, a location cho-



sen for minimum exposure to spacecraft generated magnetic fields. The magnetometer electronics is located on the top deck. This instrument will measure the strength of Eros' magnetic field to within 45nT (nanoteslas).

Data from the Galileo flybys of the asteroids Gaspra and Ida suggested that both of those bodies were magnetic but the results were inconclusive. Discovery of an intrinsic magnetic field at Eros would be the first definitive detection of magnetism at an asteroid and would have important implications for its thermal and geological history.

The Radio Science (RS) Experiment will use the NEAR telemetry system to determine the gravity field of Eros. RS will measure the two-way Doppler shift in radio transmissions between the spacecraft and Earth, to an accuracy of 0.1mm/second. These measurements will determine line-of-sight velocity variations in the spacecraft motion, which will be analysed for the effect of the asteroid's gravity field on spacecraft accelerations. Combined with data from other NEAR scientific instruments, this information will allow highly accurate modelling of Eros' density and large scale density variations.

## Uneventful launch

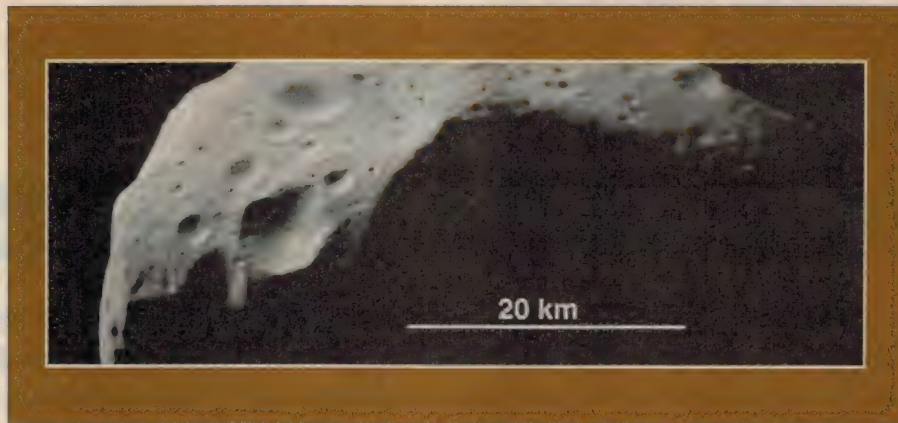
NEAR was launched from Cape Canaveral Air Force Station on 17 February 1996. Twenty minutes after launch, the spacecraft separated from the third stage of the Delta; at one hour after launch the solar arrays were successfully deployed.

Until the encounter with Mathilde occurred, the NEAR spacecraft was in a 'cruise' mode. During the first weeks of the cruise, a series of component functional tests were conducted and low level burns were performed to calibrate the propulsion system. Once these checkouts were completed, the spacecraft was in a 'hibernation' mode apart from three weekly four-hour passes with the DSN stations.

NEAR maintained this routine until June 1997, when preparations were begun for the Mathilde flyby. The flyby took place on 27 June 1997, and saw NEAR approach to within 1200km of the asteroid.

Mathilde, which has a mean diameter of 52km, was smaller than scientists estimated. A study of the asteroid's brightness showed that it reflects only 3% of the Sun's light — making it twice as dark as a piece of charcoal. NEAR acquired over 500 images of Mathilde during the flyby and these included high-resolution and colour images. (The images can be found at <http://sd-www.jhuapl.edu/NEAR/Mathilde> on the Internet.)

Once the Mathilde flyby was complete, a Deep Space Manoeuvre occurred on 03 July 1997 — the first of two major burns for the spacecraft's 450-Newton bipropellant



***This view of 253 Mathilde was acquired by NEAR when it passed close to the asteroid on June 27, 1997. Taken from about 1200km away, it shows numerous impact craters ranging in size from 0.5km to about 30km in diameter.***

thruster. This manoeuvre was necessary to lower the perihelion distance of NEAR's trajectory from 148 million km down to 142 million km.

The next critical part of NEAR's flight was to take place on 22 January 1998, when the spacecraft would make a flyby of the Earth at an altitude of 478km. This manoeuvre will alter NEAR's heliocentric trajectory, changing its inclination from 0.5° to 10.2° and reducing the aphelion distance from 325 to 265 million km. As a consequence NEAR's post-flyby trajectory should match the inclination and aphelion distance of Eros' orbit, to significantly reduce the magnitude of the rendezvous manoeuvre.

## First sight in '98

The first detection of Eros by the Multispectral Imager is anticipated to occur in Spring 1998 — approximately 200 days before closest approach. Following this early observation, clusters of images will be obtained weekly for optical navigation and for initial shape plus rotation determination.

Beginning on 09 January 1999, a series of four rendezvous manoeuvres with the main thruster spaced at seven days apart will slow NEAR by 949m/s to achieve a relative velocity of between the spacecraft and Eros of 5m/s.

The rendezvous burn sequence is targeted to put NEAR into an initial slow flyby trajectory, with closest approach to Eros scheduled for 06 February 1999. It's planned that NEAR will flyby the asteroid on its sunward side at a distance of 500km. The first pass is expected to provide improved estimates of Eros' physical parameters, which are critical for navigation.

As the spacecraft is manoeuvred closer to Eros, estimates of mass, moments of inertia, gravity harmonics, spin state and landmark locations will be determined with increasing precision. A search will be conducted for satellites and debris around Eros, which will pick up any bodies larger than five metres.

Since the orbit plane during rendezvous

will be near the Eros terminator, most of the observations obtained during the NEAR mission will be at Sun-asteroid-spacecraft angle. These angles are favourable for imaging, but not for infrared spectral mapping. Since phase angles during the initial flyby are relatively low, scientists anticipate more than 30 hours of observations that are not accessible within the nominal rendezvous geometry. This will provide an opportunity to obtain global infrared spectral maps under optimal lighting conditions.

The spacecraft will then be manoeuvred into orbit around Eros, using its small hydrazine fuelled thrusters. Mission controllers will then direct NEAR into an initial high orbit of 200 by 400km, then gradually circularise the orbit and tighten its radius as parameters are determined with increasing precision.

The NEAR science phase at Eros is planned to begin on 15 March 1999. For the following 10 months, the spacecraft will operate in a range of orbits with radii as small as 35km, corresponding to altitudes as low as 15km above the asteroid surface. These lower orbits will provide the main opportunities for close-in gamma-ray and X-ray measurements. Many of the mission's observations will be made in the 50km-radius orbit.

NEAR may provide clues to such long-standing scientific questions as the nature of planetesimals, the origin of meteorites and the relationships between asteroids, meteorites and comets.

By the official end of the mission on 31 December 1999, NEAR should have provided the first comprehensive picture of the physical geology, composition and geophysics of an asteroid.

The author wishes to thank Tom Coughlin of Johns Hopkins University, Margaret Persinger of the Kennedy Space Center and Steve Fleming 'The Starry Messenger' for their assistance in the completion of this article. The photos are by courtesy of NASA and Johns Hopkins University. ♦



# JC25 TWO-WAY BOOKSHELF SPEAKERS

We recently had the chance to check out Jaycar's new baby in their do-it-yourself loudspeaker family; the JC25 two-way bookshelf system. At an all-up price of only \$339, we expected the system to offer only a 'reasonable' level of performance and power handling — but as it turned out, both our listening and instrument tests proved otherwise...

by ROB EVANS

The sub-\$500 bookshelf speaker market is certainly not the place for faint-hearted loudspeaker manufacturers. It's probably the most competitive area of speaker sales these days, with most hifi stores hosting a battle between a range of imported and locally produced compact systems, from both large and small companies. In practice, any bookshelf system that doesn't offer the right balance between performance and price just won't survive this slugging match, and will quickly fall by the wayside.

It stands to reason then that *kit* speaker systems such as the JC25 featured here are at a considerable advantage in the tough bookshelf speaker market, thanks to the cost savings achieved by putting them together yourself. As long as the final performance is up to scratch and the assembly process is not too difficult, a kit-based system is well worth considering when buying new set of bookshelf loudspeakers.

The components used in the JC25 kit system are typical of those used in most bookshelf speakers, with a small bass driver and a dome tweeter housed in a very compact enclosure (187 x 197 x 287mm), and configured as a two-way system. Here the bass driver is one of Jaycar's own Re/sponse brand units which has a nominal diameter of 130mm (i.e., a 5" driver, in old money) and features a very large magnet assembly, a polypropylene cone with a rubber surround, and a power rating of 40W.

According to the reference material supplied by Jaycar, this bass driver has a total Q-factor (Qts) of 0.39, a free-air resonance of 58Hz and an equivalent compliance volume (Vas) of 6.85 litres. These are quite impressive parameters for such a small driver, and make it ideally suited to a compact vented enclosure tuned to its resonant frequency — such as the seven litre, 57Hz-tuned box used for the JC25 system. On paper at least, this seems like a very nice little driver indeed.



***The JC25s are very attractive, in elegantly chamfered cases finished in durable matt black vinyl. One grille has been removed here to reveal the drivers. Considering their small size and very reasonable price, the performance is very impressive.***

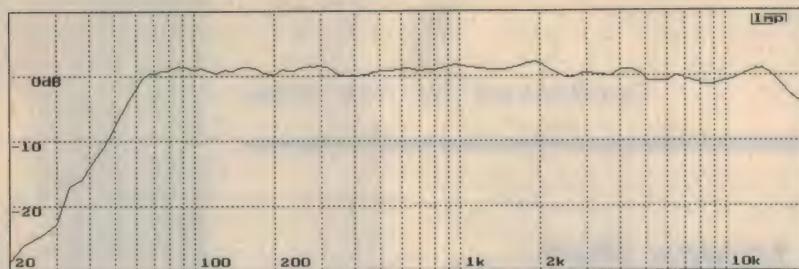
The high end of the JC25's audio spectrum is handled by the well-known Vifa D19 dome tweeter, which features a 19mm polymer dome coupled to a ferrofluid damped voice coil, plus a high-frequency range that extends to nearly 20kHz.

Both drivers are recessed into the front baffle panel, and the enclosure's tuning is taken care of by two 25mm diameter plastic ports featuring flared ends.

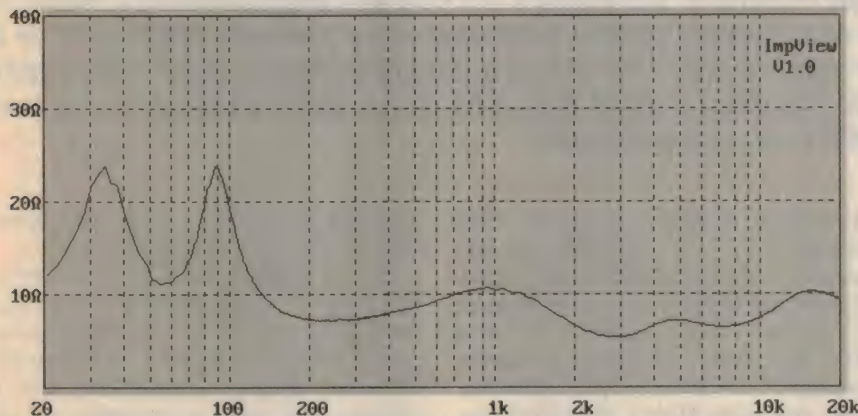
From a signal point of view, the acoustic

output of the two drivers is controlled by a second order two-way crossover which splits the upper and lower frequency bands at around 5kHz — a surprisingly high figure for a two-way system. The crossover includes a phase compensation network across the bass driver plus a tuned frequency trap circuit in series with the tweeter unit, indicating that the circuit has undergone a fair degree of fine tuning during the JC25's development stage.





**Measured frequency response of the JC25s in a typical domestic environment — very smooth indeed.**



**The measured impedance plot also has no nasty surprises, with smooth peaks either side of the 57Hz tuning point...**

## Surprising tests

Regardless of the quality of the drive units, enclosure and crossover network though, the bottom line here is really how all of this combines together acoustically in practice. For the review speakers, this was judged through a range of subjective and objective tests performed in a typical home environment (that is, I took the JC25s home, and told the kids to be quiet for a while) with the instrument checks handled by our computer-based IMP testing system.

Starting with the subjective testing, it soon became clear that these speakers delivered far more than the 'reasonable' sonic performance I would have expected from a low-cost bookshelf system. This was in fact the first in a series of surprises from the JC25s.

The overall sound was very smooth over a wide bandwidth, showed no evidence of phase-induced shifts in the stereo image (seemingly a common problem with two-way bookshelf systems), and exhibited the fast transient response that's typical of systems based on a small diameter bass driver.

The JC25s also delivered a convincing low-end performance for their size, with no sign of distress or frequency doubling effects from the bass driver when dealing with sustained low frequency signals. It was this observation that led me to the second of the

JC25's surprises, and that is its ability to handle very high power levels with a minimum of fuss.

In short, the JC25s seem almost unburstable. In spite of their 40W RMS power rating, they can be pushed very hard without suffering from a significant increase in the apparent distortion level. In fact, their ability to produce a clean sound while handling high power levels can be quite deceiving, since you sometimes don't realise just how hard you are pushing them — as it happens, my 60W RMS test amplifier complained first...

Being a small bookshelf system of course, the very low bass output is not really comparable to that from larger systems, so an add-on subwoofer would be a worthwhile addition to the JC25s. The low-end rolloff seems quite steep, yet smooth, so I'd imagine that a subwoofer could be acoustically matched to the system without much difficulty.

The only other aspect of note uncovered by the listening tests was a slight peakiness in the extreme upper end of the tweeter's response. This seemed to add a small degree of top-end sizzle to some program material, which may or may not be considered as an advantage — it's really just a matter of personal taste.

After the listening tests had shown that

the JC25s could deliver a very clean output over a wide range, it wasn't really surprising to find that the objective tests supported this impression. My preconceived ideas on how a low cost bookshelf system can sound were now well and truly shot down in flames, with the JC25s exceeding all of those expectations.

As you can see from the measured frequency response shown here, the output from the system is very linear over its operating range. The low frequency end is particularly flat down to the system's rolloff point of 60Hz, while the midrange area is also very smooth through the normally troublesome crossover area — in this case at 5kHz. Note that this response plot was taken with the speakers positioned normally in a fairly typical domestic environment, so this quite impressive result can certainly be considered as a 'real world' plot.

The other tangible result of the testing with our IMP measurement system is the JC25's overall impedance plot, also shown here. As you can see, the trace shows the normal vented enclosure 'double hump' at the low end, with the dip between the two humps corresponding to the enclosure's 57Hz tuning point.

The plot also shows a range of impedance shifts through the upper frequency area due to the correcting action of the crossover network. A minimum of around 5Ω occurs in the 3kHz area — which won't worry newer amplifiers — while the system itself has a nominal impedance rating of 8Ω.

So all in all, I was very pleasantly surprised by the performance delivered by the JC25 system. As with most speakers that perform well the result is not really due to any one component or factor, but rather the successful integration of all of the components through good design — in this case, courtesy of speaker designer Phil Routley.

According to Jaycar, the JC25 kit is supplied with all of the required parts plus a set of assembly instructions, while a complete 'internals' kit (everything but the enclosures) is available for \$169. The enclosures are priced at \$199, so the full kit price of \$339 looks like a very good deal indeed. ♦

## JC25 KIT SPEAKERS

**A set of two-way bookshelf speakers available in kit form.**

**Good points:** Excellent sound for the price. Low distortion at high power levels.

**Bad points:** Can't really produce very low (sub-60Hz) bass, but that's what you'd expect from a small bookshelf speaker system.

**RRP:** \$339 for the complete kit. Or separately, \$169 for the internals and \$199 for the enclosures.

**Available:** All Jaycar stores.





## **Revisiting a few of the topics that we looked at (or argued about) last year...**

Rather than launching into some new topic for debate this month, we're looking again at some of the topics we discussed in the last six months or so. There's the one and only response I received following my editorial on the death of a Sydney service technician who had been 'exposed' on a TV current affairs program, another letter about those old-type double adaptors which transposed active and neutral, and a letter from the other side of the world which tackles both the safety of auto-transformers and the status of the servicing industry.

As I sit down to prepare this month's column, it's early January and I'm at home — nominally on my annual 'break', although deadlines still keep on rolling around every month. It's also uncomfortably hot and sticky (more like Sydney's usual February weather), and although I'm dressed rather less formally than when I'm at the EA office, I still can't work up much energy to tackle exciting or controversial new topics. So if it's alright with you, we'll just revisit a few of the topics we looked at and/or argued about during 1997.

First of all, you may recall that in the October issue, I wrote a special replacement editorial commenting on the very sad news that a Sydney electronics service technician had allegedly committed suicide after a popular TV current affairs program had carried an item about him. I made the point (perhaps labouring it a bit) that people should be extremely careful about accusing service technicians of dubious practice on the basis of 'tests' with simulated faults, because of the enormous difficulty of creating simulated faults that aren't in reality much harder to find than real ones — regardless of how simple and 'obvious' they may seem to the person creating them...

I found it a bit curious that this editorial generated almost no response at all. (Mercifully there were no lawsuits either, so I guess I should be grateful!) This sort of silence always makes me wonder if I've either made everyone so upset that they've retreated into a stunned silence, or I've been so dead boring that no-one could even bother reading it to the end and finding out what it was about!

I suppose at least one person must have persevered to the end, though, because I did receive one solitary letter. It came from Mr Rex Shaw, a technician who appears from his letterhead to run a sales and repair business ('Shaw's Riverland Sales & Service') in Barmera, South Australia. Here's what Mr Shaw wrote, with some welcome reassurance:

*I have just read your Editorial in Oct. 1997 re the suicide of the technician, and I feel the industry and myself as a technician owe you a thank you for doing your part on the issue and doing it so very well.*

*In this particular case I thought comments about no soldering being done on PCBs was ludicrous. I often spray the area re-soldered with RF electronic circuit board cleaner and brush it over. The board then looks new and I think I can safely defy anyone to tell the work was done by looking at the solder side of the board. Of course, if this guy had done that, you would think he would have said so; but maybe on the spur of the moment he was just taken aback.*

*Another thing I seem to remember being done to presumably check people out is to replace a fuse with a blown one and then say it was only five mins to locate and replace a fuse. However, any Tech that values his business and reputation would go further than that in the quest of why the fuse had blown, and in certain cases may well replace some part suspected as the possible cause — for any number of reasons.*

*Sure (as you say) there are some dishonest techs about; we have all seen their work. However it takes a lot more effort than the popular TV current affairs program put in before it is reasonable to*

*publicize the case as they did. The drama that ensued is proof enough of this.*

*On the surface, the case as presented did seem to suggest the possibility that something was amiss; but that was not anywhere near enough to justify putting the whole thing on national TV. Even if the guy was guilty as charged, did the punishment fit the crime? No, definitely not. It was way too harsh and this comment goes irrespective of the dire consequences in this case.*

*Anyway, thanks again on behalf of the industry for a very well worded article. Personally I feel the TV program has not proved the case and should be sued very heavily indeed and/or compensate the family.*

Thanks indeed for your support, Mr Shaw. As you say, finding and replacing a blown fuse may only take a few minutes, but any experienced and reputable technician will not want to stop there — realising that there's usually a cause for the blown fuse, and unless this is found and remedied, the equipment will usually return in short order (accompanied by an appropriately irate owner). To paraphrase W.S. Gilbert, it all goes to show that a service technician's lot is not an 'appy one', doesn't it?

Anyway, I'm grateful to Mr Shaw for taking the trouble to write. It was nice to know that *somebody* read the editorial in question, and even agreed with it!

### **Double adaptors**

Moving on, you may recall that we discussed the hoary old topic of double adaptors and electrical safety in a couple of columns last year. First of all there was a letter on the April column from Muswellbrook reader Jim McCloy, tak-





ing both Vintage Radio columnist Roger Johnson and myself to task regarding comments we'd made, and then in the November column I ran part of a letter from Melbourne engineer Alan Fowler, gently correcting some of Mr McCloy's claims. Mr Fowler gave an example of a faulty examination lamp at his doctor's surgery, where the fault and its potential danger was 'hidden' by fact that it had been plugged in via an old-type 'transposing' double adaptor.

Well, here's another episode in this ongoing saga, which came in the form of an e-mail message from reader David Timmins — who from his e-mail address seems to be part of electronic music firm Jands Electronics. And as you can see, he seems to be 'having a go' at both Mr McCloy and Mr Fowler:

*I have a few comments on the double adaptor - is it safe? issue.*

*I would argue that reversing double adaptors are still safe. I can't think of any piece of equipment where swapping the active and neutral conductors would result in mode of operation that is unsafe, because the neutral conductor should **always** be treated as if it were active. Note AS3000 reflects this by ensuring the insulation standards applied to the neutral conductor are the*

*same as for the actives. In my opinion anyone who treats the neutral conductor as anything but active is very likely to die by electrocution.*

*The example given [by Alan Fowler] is completely inappropriate — the fault was 'clearly in the lamp. The reversing double adaptor only served to highlight that something was faulty. In fact if a reversing adaptor wasn't used the doctor may never have found out (until it was too late) that his lamp was faulty.*

*Don't get me wrong — I think that maintaining active and neutral wiring throughout all products is good practice. But unsafe, I don't think so.*

Hmmm; thanks for those comments, David. I agree that when you think about it, those old type double adaptors probably weren't in themselves all that dangerous. Simply transposing active and neutral shouldn't cause any problems, with normal use of equipment that is designed and built to the appropriate safety standards, and not faulty.

I guess the main problem is that there's still quite a bit of equipment around (including vintage gear) that either wasn't built to today's standards, and/or has since developed various faults. And this kind of equipment *can* become more dangerous to operate — or

especially, to service — if it happens to be connected with its active and neutral transposed. Which doesn't require an old-type double adaptor, of course; it can happen just as easily if the plug has been wrongly wired.

To me, the main message that comes through in all of these discussions is that before working on *any* mains-operated equipment, it's very wise to check the mains wiring and its insulation. You and your loved ones only live once, and a jolt of 240V-sourced current through your thorax can be fatal.

## Auto-transformers

Still on the subject of electrical safety, let's move on again to revisit another related aspect: the risks associated with auto-transformers, of the type used for stepping 240V down to 120V. You may recall that Sydney technician and frequent contributor Phil Allison raised this matter again in the December column, and we discussed in again briefly last month.

As it happens I've had some comments on this subject, this time in a letter from a reader on the other side of the world: Mr Paul Coxwell, who lives in England — in a town in Norwich, with the picturesque name Eccles-on-Sea.



(Sounds like something from one of the old Goon Shows, doesn't it? Sorry Paul, I'm sure it's a very pleasant place.)

Paul also has a few comments on the subject of the service industry and its problems, so I feel sure you'll find his letter as interesting as I did. Here's what he has written:

*I thought I would write to add my two-cents worth to the recent discussion about auto-transformers, and also to comment on the position of service technicians that has been raised in both 'Forum' and 'Information Centre'.*

*A few years ago I purchased a small 115/230-volt auto-transformer from an American supplier and was somewhat alarmed at the way the manufacturer intended it to be used. The casing was formed by two suitably shaped covers over either side of the core. The connections at each side of the core appeared to be for two independent windings, but there must have been an internal link that could not be seen. I can't remember whether resistance checks revealed two separate windings linked at one end or a true single-winding auto-transformer.*

*Each half of the casing carried a two-pole socket of the type that will accept either an American flat-pin plug or a Continental round-pin type (similar to the outlets for electric shavers found in some hotels). The transformer was supplied with a two-core flex fitted with an American plug at one end and a Continental plug at the other. The idea, of course, was that the one flex could be used whether the transformer was being used in America to step-up voltage or in Europe to step-down voltage.*

*I found it incredible that a manufacturer would sanction such a dangerous arrangement for a piece of equipment that would be sold to the unskilled as well as the trained technician. Even with correctly wired wall sockets, there was no way of knowing whether the live and neutral connections were correct, but this danger seemed slight compared to the risk of someone touching a live plug or connecting the transformer the wrong way round and getting the best part of 500 volts at the output.*

*I wonder whether anyone else has come across such a crude set-up. Needless to say, for my required use I soon dispensed with the aforesaid arrangement and connected a three-core flex in place of the input socket to ensure correct live/neutral polarity and also to provide an earth to the frame.*

*Moving on to the subject of service technicians, I have never visited Australia, so am not in a position to pass judgment on the situation there. But I thought you may be interested in my view of the position in Britain.*

*General repair and servicing here seems to be practically extinct, except for the high-priced service shops attached to big-name retailers, and I personally gave up servicing work several years ago. The two obvious routes are a commercial shop and working from a home workshop.*

*Working from home would seem an attractive proposition, but in my experience is simply not worth the trouble. Many people seem to instantly distrust a home-workshop engineer, however good his qualifications and experience. Others seem to think that anyone working from home must be doing it as a sideline and assume that no repair will cost more than £5-10. They are usually the same people who come banging on the door at 9pm and expect instant service.*

### **New problems**

*The alternative route, that of a full commercial shop, brings a new load of problems. Business rates (property taxes) are extortionately high in Britain, as are charges for water to a commercial property, even if it contains just a single WC and wash basin. These two items alone could easily come to the equivalent of \$3000 Australian per year or more. Add on annual rent for the building and that figure can be increased several fold.*

*Then we have the dreaded value-added tax, or VAT (equivalent to GST or sales tax in other countries). On most items VAT is charged at a whopping 17-1/2 percent at the moment, which represents a substantial chunk of the customer's final bill. VAT also means yet more paperwork, courtesy of H.M. Government. Businesses with a small turnover do not have to register, but there is little to be gained since they then have to pay the extra 17-1/2 percent on all supplies. Any establishment below the turnover limit is not likely to be in business for very long anyway.*

*A commercial workshop then brings in the dictats of a whole range of other officials, such as Health & Safety Inspectors who have swallowed a book of rules and regulations, now supplemented by EU directives with which we have been burdened.*

*If, by any chance, the above fails to put the enterprise out of business, trying to take on just one employee is likely to do so. More mountains of paperwork are needed to process pay-as-you-earn income tax deductions, national insurance contributions, and so on. Having an employee tightens up the Health & Safety Regulations, requiring a myriad of warning notices, 'staff' facilities, and so on. Employment legislation has reached ridiculous levels: It seems that employees can now do practically anything they like and cannot be fired, whereas employers have virtually no rights whatsoever. The cry of 'discrimination' goes up at the slightest difference of opinion.*

*Add the ever-increasing emphasis on buying new [equipment] rather than repairing, and the future seems bleak indeed. As for taking on young people to learn the business from the ground up, they would probably be better off working at McDonald's.*

*I would hope that the situation is somewhat different in Australia, particularly in remote outback towns that don't have easy access to big city facilities. If you have a good local serviceman, hold on to him! Meanwhile, is there anybody who could use the services of a Pommie technician who'd be only too happy to oblige, no whingeing?*

*Thanks very much for those comments, Paul, and also for the Christmas and New Year messages you included with your letter. It's nice to know that we have at least one supportive reader in England, and I trust you had a pleasant festive season too.*

*That auto-transformer you describe certainly sounds pretty scary in its original state, I agree. Especially with the cables ending with a plug at each end! As you say, surely that kind of thing would be illegal even in the USA...*

*I can't say I've ever seen anything quite that dangerous out here, although I seem to recall a 240V/115V transformer that came with an old 16mm movie projector being almost as bad. It had exposed terminals on the 115V side, I think — and I had to make a special protective cover for them before I deemed it safe enough to use.*

*From your description of the state of the servicing industry in the UK, Paul, it sounds as if there are quite a few similarities with our own. We mightn't have quite as many rates and taxes to make things as difficult (although the present Federal Government seems to be working itself up to giving us a GST before*

*(Continued on page 59)*



# THE SERVICEMAN



## *The set that could easily have killed its owner — and it's probably not the only one!*

Our first story this month is a really scary one, and not just because the recent-model CTV set concerned developed a fault which made the antenna socket 'live' and potentially lethal. The real worry is that quite a few recent-model sets are probably capable of developing the same dangerous fault. There's also the story of a European-made Sony set which first wouldn't turn on, and then suddenly started changing channels madly...

This month we begin with a story that is truly frightening in its implications. It points to at least one make and model of television set as being potentially lethal.

The story comes from Roland Kroes, of Mullumbimby in northern New South Wales. As you will see, the set in Roland's story came close to killing its owner and at the very least could have caused fire or serious injury. Here is his story...

*In the past I have been close to writing to The Serviceman about some of the repair jobs that I have encountered, but I have never actually got around to it. This time however I came across a situation that caused quite some concern for my customer and should really be of concern to everyone.*

The story started about a year ago, when a friend of mine, a 'sparkie' who spends most of his time installing TV antennas, came in with an antenna booster and asked me if I could have a look at it. I proceeded to do so immediately, whilst my friend was still there. I found that the booster's filter capacitor, a 470uF 35V electro, had blown clean off the board. Its remains were clinging to the insides of the little plastic box.

I quizzed my friend about how this could have happened, but he had no idea. Once the capacitor had been replaced and the booster hooked up, my signal strength meter told me that all was operational, there being some 30dB of gain.

It was then revealed that this booster was an in-line component in an antenna system that comprised two boosters and some 300 metres of cable running 'up the hill'. We eventually put the whole episode down to a possible lightning strike, and my friend took the thing away.

I didn't think about it again, until about eight months later when there was a repeat of this situation, which

was again put down to lightning and attended to in much the same manner.

Everything appeared to work OK until last week, when I was told that there had been more reception problems. The owner of the antenna system had gone up the hill and undone the lead from the masthead amplifier. He had then received a severe shock from the end of this lead and when he dropped it, it touched a steel picket and there was a large flash. This had also tripped a recently installed Earth Leakage Circuit Breaker in the house.

My friend was called in again and he discovered that the antenna socket on the back of the TV had 240 volts AC on it!

I tried to explain that this was leakage due to the high impedance meter he was using, but he interrupted me to say that he had been able to light a globe by connecting it between the antenna socket and ground, at least until the ELCB tripped again.

This set off the alarm bells, and I told him to bring the TV set around straight away. It turned out to be a 68cm model, about three years old, with a flat black square screen, etc. I put an ohmmeter between the active terminal on the power plug and the antenna socket. It read 15k $\Omega$ .

A quick glance at the circuit diagram revealed that there should be at least 8.2 megohms between the 'hot' and 'cold' parts of the circuit. This is the value of a tiedown resistor which is paralleled by two series connected (and mains rated) capacitors.

This network ties the secondary earth of the set to the primary earth, at least as far as static charges and RF are concerned. In fact, the 'Primary Earth' is not really an earth at all, but is at a 125V potential to mains earth.

As with most modern sets there is a switch-mode power regulator which is fully isolated from the rest of the set.

The only other components between the regulator and the rest of the set are the chopper transformer and a relay. So where could there be 15k of leakage?

The most likely contenders had to be the two capacitors in parallel with the tiedown resistor, but checks revealed these to be above board. The next best had to be the transformer, so out it came. But any test I could devise cleared this component completely.

Now grasping at straws, I also removed the relay. The resistance between active and secondary ground had now gone down to only 10k $\Omega$ !

By this time I had nearly everything unplugged when my eye fell on the degaussing coil connector, which was still plugged in. Suddenly an idea dawned. Could it be? It was...

With the ohmmeter between the coil's connector and secondary ground, I could wiggle the coil around the back of the picture tube until I had the resis-

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tance down to 10 ohms!

The degaussing coil, which is wired directly across the AC mains in series with a thermistor, consists of a number of turns of light gauge enamelled wire — insulated in this set by a single layer of PVC insulation tape.

This is mounted directly onto the back of the picture tube, the metalwork and aquadag of which are tied to the secondary earth, as is the metalwork of the tuner and the antenna socket.

To make things even worse, the thermistor in this particular set is in the neutral line. This means a worst-case possibility of zero ohms between the AC active line and the antenna socket!

After removal of the coil, a visual inspection revealed absolutely no sign of damage to the insulation even though some large sparks had reportedly occurred.

*I insulated the coil with more PVC tape, using no less than two rolls. This solved the problem and a subsequent check with the ammeter showed that an AC current of only 560uA would flow between the antenna socket and a nearby earth point.*

While some people might feel a tingle from that, it is quite normal and in itself not dangerous. It becomes a different situation however when the antenna sockets of a number of these sets are tied together, as through the antenna distribution system of a large motel for instance.

The most disconcerting part of this story is that, when I contacted the manufacturer to inform them of the situation, they dismissed the entire thing, claiming that if this happened it would completely blow the power supply anyway.

*Which of course is not true, since all it would do would be to put 240V AC across the 8.2 megohm tiedown resistor between the 'hot' earth and the 'cold' earths of the set.*

*I don't know why, in modern sets with an isolated SMPS, the secondary earth cannot be properly grounded via the earth pin on a three-pin power plug, since there really isn't any reason to keep this earth floating. It seems to be a kind of hangover from the days when we had 'hot chassis' sets in which the entire chassis was at the 'half mains' potential, and the antenna sockets themselves were isolated through high voltage capacitors.*

The whole experience made me wonder what 'Double Insulated' really means. Two layers of insulation tape perhaps?

So there you are! A highly dangerous situation, if ever there was one.

Originally, TV sets were fitted with a power transformer which effectively isolated the works from the mains. A three-core cable allowed a proper earth link to tie the chassis to ground.

Then came transformerless sets, with no provision for earthing, and fitted with a two core cable. It was during this era that the concept of 'Double Insulated' was introduced and for the most part, it was safe and reasonably reliable.

It was possible to defeat the double insulation to produce a situation such as described in Mr Kroes' story, and I have reported at least one such tale in these pages. But it took a deliberate mischief to do this — an accidental fault was unheard of, at least in my experience.

However, in recent years it has become necessary for designers to make

provision for the direct connection of audio and video sources, as from a VCR or DVD player. This has called for a properly isolated chassis and the design based on that described in this story has become mandatory.

So now, with the set isolated from the mains, designers could dispense with the high voltage capacitors in the antenna socket. That would please the bean counters! It prunes quite a few cents off the production costs. But it also sets the stage for the problem described above...

When you think about it, it's surprising that there haven't been more reports of this kind of accident.

What would have happened if a VCR had been connected to the set in question. The whole machine would have been charged up to 240V AC! That wouldn't have done the tapes much good! And the antenna would have been enlivened just as in the story above.

And what about rabbit ears antennas? While Mr Kroes' 68cm set was unlikely to be used in the kitchen, many smaller sets with the same internal arrangements are so used these days. Imagine if the fault occured as the owner adjusted the rabbit ears, while touching a toaster or some other properly earthed appliance!

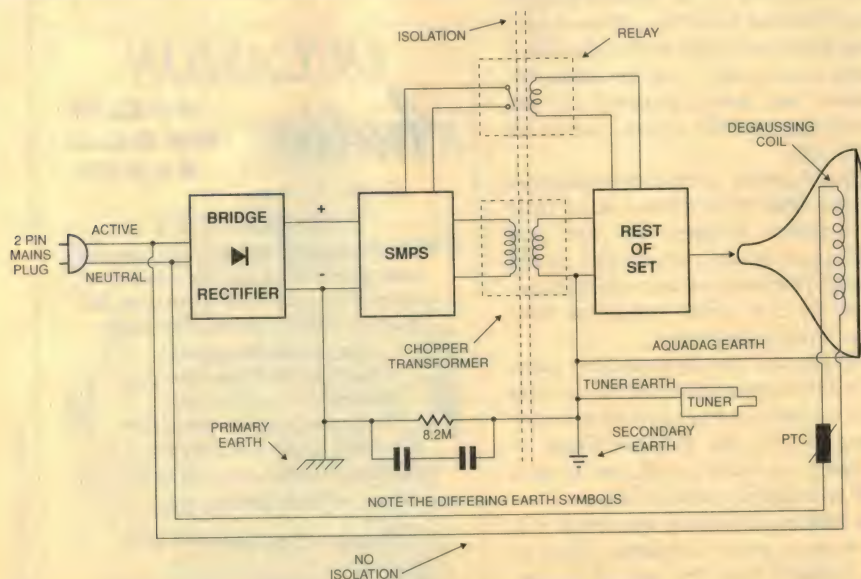
As I have mentioned, this kind of circuit arrangement is now quite common and there must be thousands of potentially killer sets in the field. The question arises — what can be done about it?

Regular readers will recall this whole 'Double Insulated' scenario was thoroughly discussed in Forum a year or two ago. At that time it was decided that no result was possible, since commonsense suggested one course of action and the standards people dictated another.

Mr Kroes did not mention the brand, since as he states, he is a service agent for the brand in question. However, the brand is irrelevant in any case since the same or a similar circuit is used in virtually any set fitted with AV connectors, and a lot of others that aren't.

It seems to me that all we can do to protect ourselves and our customers is to carefully inspect the degaussing coils of every set that comes into the workshop. Any that show signs of inadequate insulation around the coils should be given the full treatment as described by Mr Kroes.

It will also help to make sure the thermistor is in the active lead. This will ensure that the coil is only alive when



*The kind of power supply system used in the set discussed in Roland Kroes' story. Many modern sets use virtually the same system...*



the set is plugged in but not switched on. It's better than having the coils alive all the time...

I, for one, am grateful to Roland Kroes for sending in this story. It alerts us all to a possibly life-threatening situation. Thanks a lot, Mr Kroes.

## Dead, then crazy

Next, we come to another story from our southernmost contributor, Stephen Ward from Lower Longley, in Tasmania.

As you will see, Stephen rather wishes that Sir Isaac Newton had not sat down under the apple tree. Stephen calls his story GRAVITY SUCKS. This is why...

The set was a Sony model KV2212 and the complaint was '...won't switch on'. I tried, only to be greeted by the standby light and nothing else. Being an older model the first thing I suspected was the power switch, and more specifically the momentary contacts mounted on the rear of the switch which tells the microprocessor to start the power supply.

I removed the back cover, but getting access to the switch wasn't going to be so easy. This set was actually manufactured in Germany and like so many European sets, everything was crammed into the smallest possible cabinet.

The front control panel of this set was very slim, with the speaker, power switch and LED display on it. The rest of the controls were hidden under a flap on the top of the cabinet and under these buttons were two long PCBs hanging right down into the set, effectively stopping access to the power switch.

It took a while to figure out how to get these PCBs out of the way. However, it was simply a matter of removing two screws which went sideways into the wooden top of the set — right where you can't see them. Once the screws were removed the whole button assembly and associated circuit boards could be pulled upwards and laid on top of the set.

Once I had access to the power switch, I turned it on and then using a clip lead, momentarily shorted the contacts. This brought the set to life, with a perfect picture. 'Just too easy, I thought.

I quickly had a new switch installed, then flicked through all the channels. Everything looked fine. With the set still running, I lifted the button assembly and started lowering it into the cabinet.

Suddenly, the channels were changing rapidly as indicated by the LED display, and the tuner band LEDs mounted next to the buttons were flashing all over the place. Then just as suddenly the set stopped on one channel. I shook the assembly and again everything went mad.

I fitted everything back into the cabinet and started pulling at the wiring to the boards. With that, the fault came and went. 'Damned dry joints!' I thought to myself. So I switched off and proceeded to dismantle the button assembly.

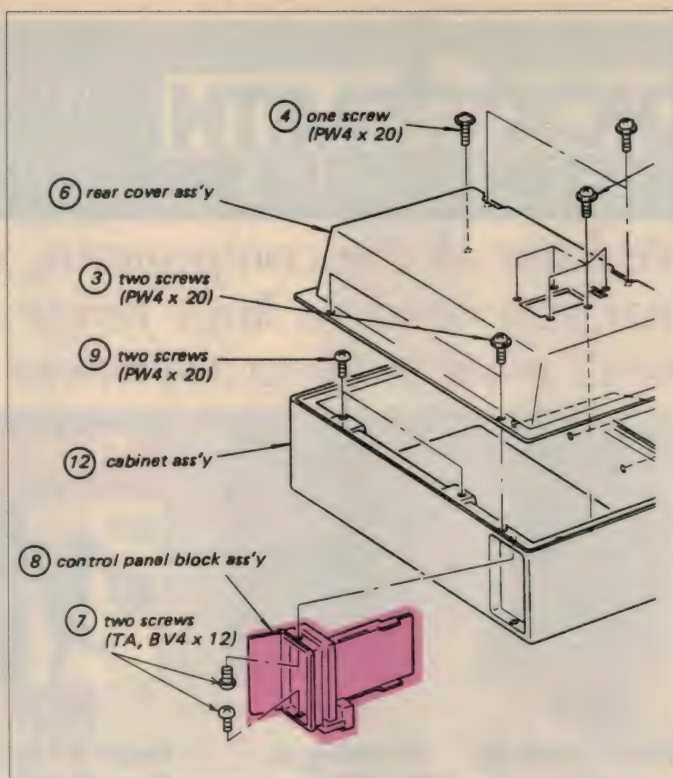
I resoldered all suspect joints and reassembled the panels with it sitting on top of the set. I bashed and prodded and flexed, without a single sign of the fault. So I told Mr Murphy to kiss my foot, but his hearing must be getting bad because he trod on it instead.

As soon as I lifted the assembly up and started fitting it back into the cabinet, the fault returned as bad as ever. With the button assembly in place, the slightest tap would send the LEDs crazy and the set would stop on a random channel. The fault only showed up when everything was back in place, not when the assembly was on top of the set!

I spent the next half an hour checking the wiring harness for loose wires or missing insulation. I even insulated any metal on the power switch and speaker that was anywhere near the PCBs, but the fault was as bad as ever.

I had the assembly in and out a dozen times, but the fault only disappeared when the assembly was lying on its side on top of the set. I jokingly thought to myself that I had a gravity related fault — but that couldn't be right, could it?

I thought more about this fault and decided it must be some-



Highlighted in this diagram from the Sony KV2212 manual is the 'control panel block assembly', which formed the focus of Stephen Ward's hassles. Without the manual, it took some time to find the two screws marked '7'.

thing to do with the channel up/down buttons, because the fault was just like pressing these buttons really quickly. I removed the plastic surround from the buttons and lifted out the PCB with the buttons attached. I had already resoldered all the joints on this PCB, so it wasn't a dry joint.

I started wondering if there was some sort of fracture in one of the PCB tracks, but considering these buttons are of the momentary-close type, an open circuit in a track should STOP them working, not make the channels change spontaneously.

While I was inspecting the PCB I suddenly noticed that the shafts on both the channel up and down switches were shorter than the shafts on the other switches on the same board. This seemed strange, as all the switches were of a similar type. It was when I pressed one of the channel buttons and then one of the other switches that it all became clear.

The channel buttons didn't have the same feel, which turned out to be due to the rubber surrounding their shafts having perished and lost its spring. This meant that the switch shaft was always sitting on top of the switch contacts, and with the help of gravity plus a small vibration, the contacts were bouncing and sending a train of pulses to the microprocessor which changed channels with every pulse.

After replacing the two switches there was no further problem. This is the first gravity related fault I've ever encountered and it just goes to prove the old saying that 'gravity sucks'.

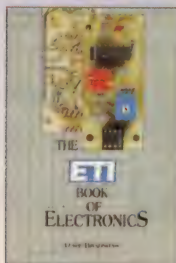
You know, there have been all sorts of useless inventions, like motor cars and mobile phones. The one Really Useful invention hasn't been made yet. If someone could invent anti-gravity, he would do the greatest service to mankind, and make a bit of money on the side!

Anyway, thanks for that little story, Stephen. As you'll see from the illustration, the two 'secret' screws were quite easy to find — if you have the Service Manual! ♦



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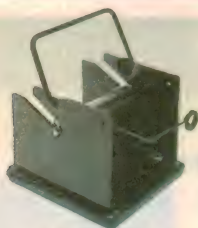
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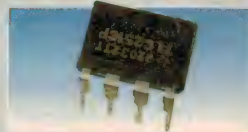
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Q 1806



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5mV/DIV - 5V/DIV
- Rise time: 5mV/DIV - 5V/DIV: 5.8ns 1mV/DIV: 17.5ns
- Hold-off time: Variable
- Main sweep speed: 0.1us/DIV - 0.2s/DIV in 1-2-5 sequence, 20 steps
- Delay sweep speed: 0.1us/DIV - 0.2s/DIV in 1-2-5 sequence, 20 steps
- Sweep magnification: 10X
- Operating modes: CH1, CH2, Alt, Chop.
- Trigger Coupling: AUTO, NORM, TV-V, TV-H
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L 8180

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# Circuit & Design Ideas

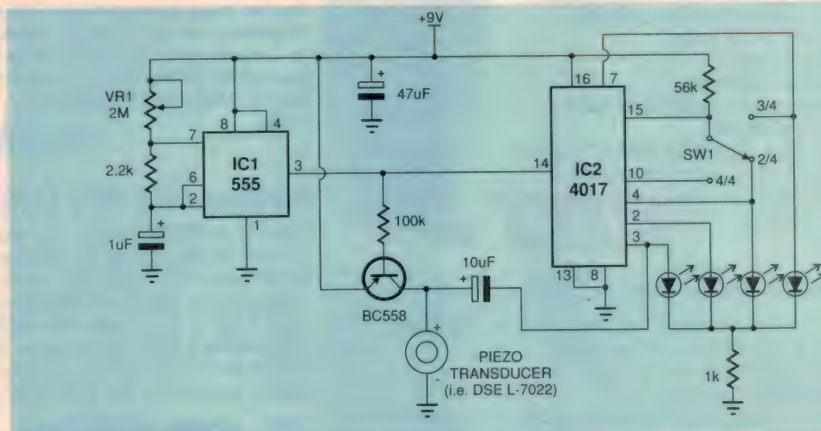
Interesting original circuit ideas and design tips from readers. While this material has been checked as far as possible for feasibility, the circuits have not been built and tested by us. We therefore cannot accept responsibility, enter into correspondence or provide any further information.

## Simple Counting Metronome with Accented Beat

Many metronome circuits have been published over the years, but few have the advantage of accented beat, and even fewer count each beat of the bar. This simple metronome has these advantages which are usually provided by only the professional models.

IC1 is a 555 timer configured to oscillate with its frequency dependent on the 2M pot, VR1 (tempo control). This IC provides the pulses that are fed into the clock of IC2, a 4017 counter. This drives the LEDs directly and SW1 selects either 2/4, 3/4 or 4/4 time.

The accented beat function is provided by Q1 and associated components. The 4017 clocks on the negative edge of the pulse and this pulse is tapped through the 100k resistor to the base of Q1, a BC548. This drives the piezo buzzer, which is used as alternative to a moving coil speaker due to its low current



consumption, simplicity and volume. When pin 3 of IC2 goes high, indicating the first beat of the bar, the 10uF capacitor 'accents'

the first beat.

Richard Graham  
Nelson, New Zealand

\$30

## Engine immobiliser with alarm

Here's an inexpensive little circuit that will thwart the attempts of the craftiest thief to steal your car. Not only is it a waste of time trying to hotwire the ignition, but the keys could be left in the ignition without undue concern.

This circuit draws no current in the stand-by state and it resets itself after starting the engine, so there is no need to remember to re-arm the unit when leaving the car.

The immobiliser comprises a bank of nine pushbutton switches. To initiate the system, two buttons are pressed simultaneously, then a third (single) button is pressed within two or three seconds of the first pair to switch on the relay. Any longer delay and

the initiative is lost, and if a wrong button is pressed it sounds the alarm.

Once the relay is energised, the circuit is completed between the ignition switch and the starter solenoid, which enables the engine to be started. Of course the three activating switches are placed randomly in the switch bank to make it practically impossible to avoid setting off the alarm if the correct procedure is not known.

When SW1 and SW2 are both pressed at the same time, capacitor C1 charges to the positive rail, turning on Q1 via resistor R2. Now, if SW3 is pressed, Q1's collector current will energise the next stage of the circuit. If there is a delay of more than a couple of

seconds before pressing SW3, C1 discharges via the bleed resistor R1 and Q1 turns off. R1 is also needed to ensure that C1 is fully discharged after it has done its job, otherwise Q1 will be held in its 'on' state indefinitely.

In the second stage, C3 charges after pressing SW3 and slowly discharges into the base-emitter junction of Q2 via the large resistor R3, so activating the relay for about 12 seconds — sufficient time to turn the key in the ignition switch and start the engine. The LED shown in parallel with the relay indicates when the latter has been activated.

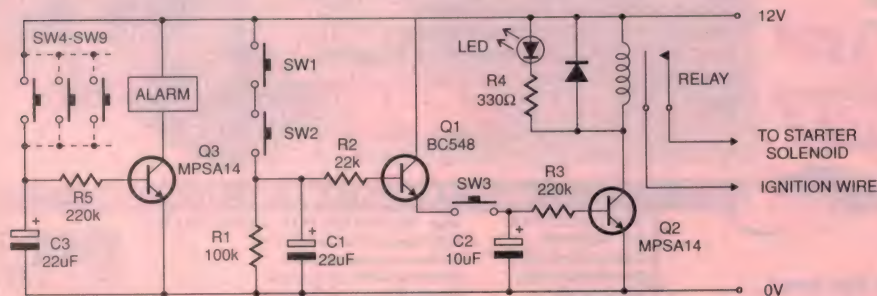
The relay is preferably located under the bonnet on the firewall, where it is safe from interference. The third (alarm) stage is similar to the relay circuit except that it is completely independent of the foregoing circuitry, and is activated by any one of the remaining six switches which are wired in parallel. For the delay periods required for the relay and the alarm, Darlington transistors are used for Q2 and Q3.

The circuit board fits neatly into the smallest Dick Smith Electronics project box, with the miniature switches mounted on the lid.

It should not be difficult to locate a live wire and an earth wire under the dash or at the fusebox to power up the circuit, and the overall unit, including the 12V auto relay and small piezo alarm can be built for under \$40.

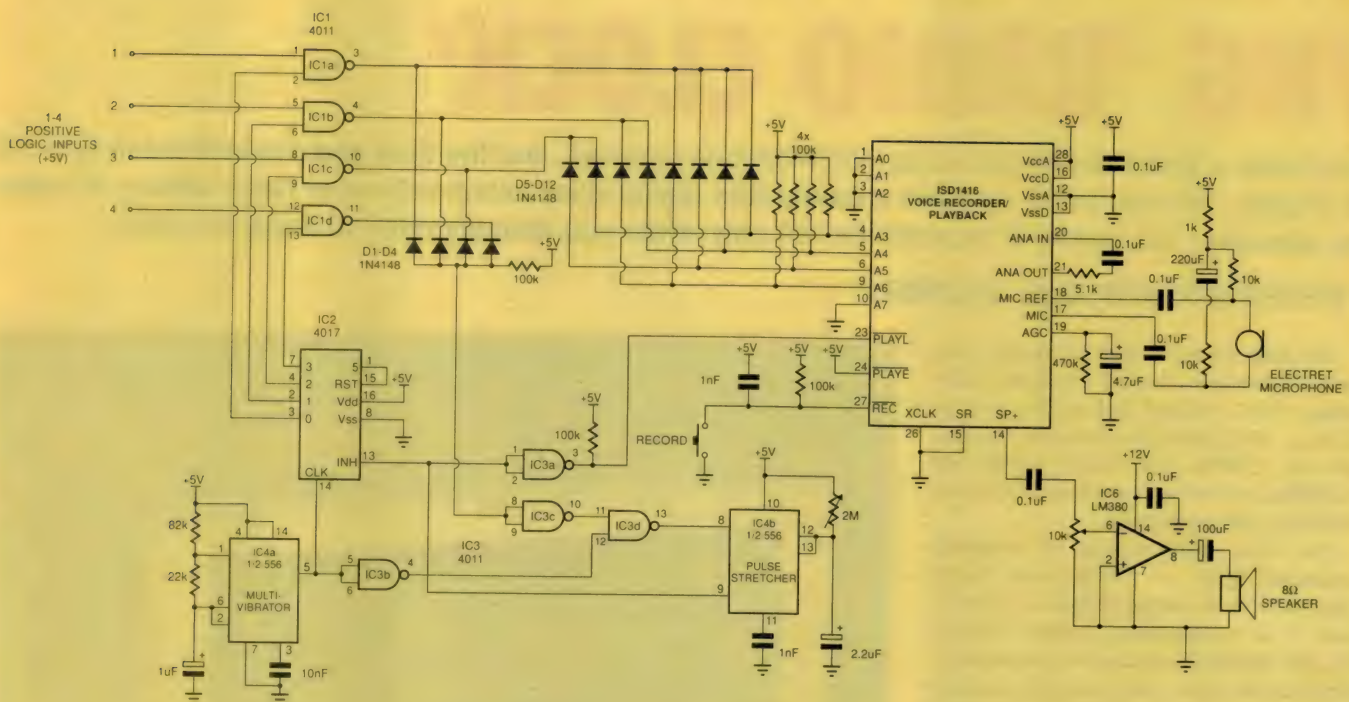
Tony Lee  
Mount Martha, Vic.

\$30





## Four by four-second voice recorder



Here is a circuit that I recently designed. It is a four by four-second voice recorder with playback, and it was simply and inexpensively done with the ISD1416 16-second recorder/playback IC available from Dick Smith Electronics.

The circuit is designed to record and play back four second messages. Its intended use in this instance is in an automobile voice indicator to alert the driver to various states such as 'Headlights on' and 'Reverse gear engaged'. Five years ago this circuit would have cost around \$150, but this one is only around \$45.

All the magic is performed in IC5, the 1416, available for around \$20. It is a 16-second recorder chip with a maximum input sample rate of 8kHz, and 3.4kHz upper pass-band. Recordings are stored in non-volatile RAM, and should last for many years with the power disconnected.

Selection of the desired message to be played back is performed by applying a positive voltage to IC1a-d. These inputs

are polled by IC2 which forms a message queuing function. Diodes D1 to D4 are an inverse logic OR gate to detect the presence of a message on queue. If one is detected, then IC4b (the pulse stretcher) will initiate playback and halt progress in the message queue until playback is complete. Adjustment of the playback length up to four seconds may be made with the 2M pot in the pulse stretcher circuit. IC4a is a monostable multivibrator which allows for falling edge detection at IC3d. IC6 is a 1W audio amplifier to drive the speaker.

The circuit is geared for playback, but recording is possible by temporarily removing IC2 and IC4 from the circuit. Then the pins of IC1 (either a, b, c or d) are taken high to select the record address. Do not go over four seconds for each message, as the end of message marker will be lost and the messages will stream into one another on playback.

I hope you find this circuit useful, as there is now no reason not to have those

messages that come in the more expensive models of cars.

Anton Makotter  
Plympton Park, SA \$40

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### WIN OUR 'IDEA OF THE MONTH' PRIZE!

As an added incentive for readers to contribute interesting ideas to this column, the idea we judge most interesting each month now wins its contributor an exciting prize, in addition to the usual fee. The prize is a complete closed circuit TV system, comprising a 5" B&W video monitor, CCD video camera with stand, power supply and cabling. This system comes from our sponsor Allthings Sales & Services, and is valued at \$369.00!



# A SELF-SETTING VNG 'RADIO CLOCK'

If you have a spare shortwave or communications receiver, and the time and the inclination to build this project, you can make yourself a handy little digital clock which will never need setting. It's also very accurate, but needs to be switched on only when you actually need to know the time.

by PETER STUART, B.E., VK2BEU

The time source for this interesting clock is the Australian time and frequency radio station VNG, situated at Llandilo, west of Sydney. VNG transmits on five HF frequencies of 2.5MHz, 5.0, 8.638, 12.986 and 16.0MHz, and has wide coverage throughout Australia and its territories.

The VNG signal consists of amplitude modulated 'pips' of 1000Hz tone, which serve as seconds markers. However, as can be seen in the accompanying diagram, between the 20th and 46th second of every minute the length of the pips is used to serially transmit the binary-coded-decimal (BCD) equivalent of the hours and minutes of the time of day, together with the day number of the year. The 100ms pips represent logic zeros and 200ms pips represent logic ones.

A microcontroller is used in this clock to decode the pips and display the time on a liquid crystal display (LCD). The time is shown in six-digit format, along with the day number of the year, or day of week if preferred. Although the time is transmitted by VNG as Universal Coordinated Time (UTC), presettable DIP switches allow the time to be selected for any time zone in the world, by adding or subtracting the hours east or west of the Greenwich meridian. Half-hour increments can also be included to cater for our friends in South Australia. No alarm or time switching facilities are provided.

The circuit uses a Motorola 68HC705-C8 microcontroller to do the decoding, perform the calculations and drive the display. Ahead of the microcontroller is an active narrow bandpass filter using a CA3130 op-amp. The filter is centred on 1000Hz and provides immunity against noise and nearby interfering stations. Further processing of the signal is performed by the microcontroller as will be explained later.

The filtering and signal processing allow the clock to perform well under good-to-average HF conditions. However, under poor conditions, which include rapid fading or heavy static, reliable decoding of the time cannot be assured. Under these conditions, changing to another frequency usually helps,



and in this regard, access to all five VNG frequencies is necessary.

So before commencing this project, check your shortwave receiver to make sure it can receive at least four of the five frequencies, and spend a week or so logging the frequencies at various times of day to ensure you have reliable reception. Note that the 16MHz transmission ceases during nighttime over Australia (1000hrs-2200hrs UTC).

## Circuit description

The CA3130 op-amp functions as a multiple feedback bandpass filter centred on 1000Hz, with a gain of 16 and a bandpass of 100Hz at the -3dB points. Attached to its input are a 1k $\Omega$  resistor and two diodes, which prevent excessively loud signals from swamping the filter.

I fitted a small speaker inside the clock, with a mute switch (S1) and 8.2 $\Omega$  dummy load. This is because most communications receivers will mute the speaker when a jack plug is inserted into the EXT SPKR socket.

The ability to hear the signal is useful when first switching on, as will be explained later. The ability to switch it off will stop you going mad!

The rest of the audio circuit is devoted to producing a 5V logic compatible signal for the microcontroller from the 1000Hz signal filtered by the CA3130. This signal still contains some low level noise, so two comparators inside the LM393 chip separately square up and rectify the positive and negative halves of the sinewave whenever it goes above 2/3 or below 1/3 of the supply voltage. Noise is generally within the middle third of the supply voltage range at this point, and all but the strongest noise bursts are effectively removed.

Each comparator has one half of a 4013 D-type flipflop connected to its output, to extend the squarewave pulses from each comparator so they overlap each other. This is necessary to fill in the small gaps which occur in the comparators' high outputs as the 1000Hz sinewave passes between the upper and lower trip points on the comparators.







pulse is due to arrive. This prevents false starts due to unwanted signals such as strong static bursts between seconds markers.

There is one anomaly in the pulses transmitted by VNG: there is no marker transmitted for the 59th second. The program takes care of this by going into a one second delay after the start of the 58th second. It then increments the seconds display at the end of the delay.

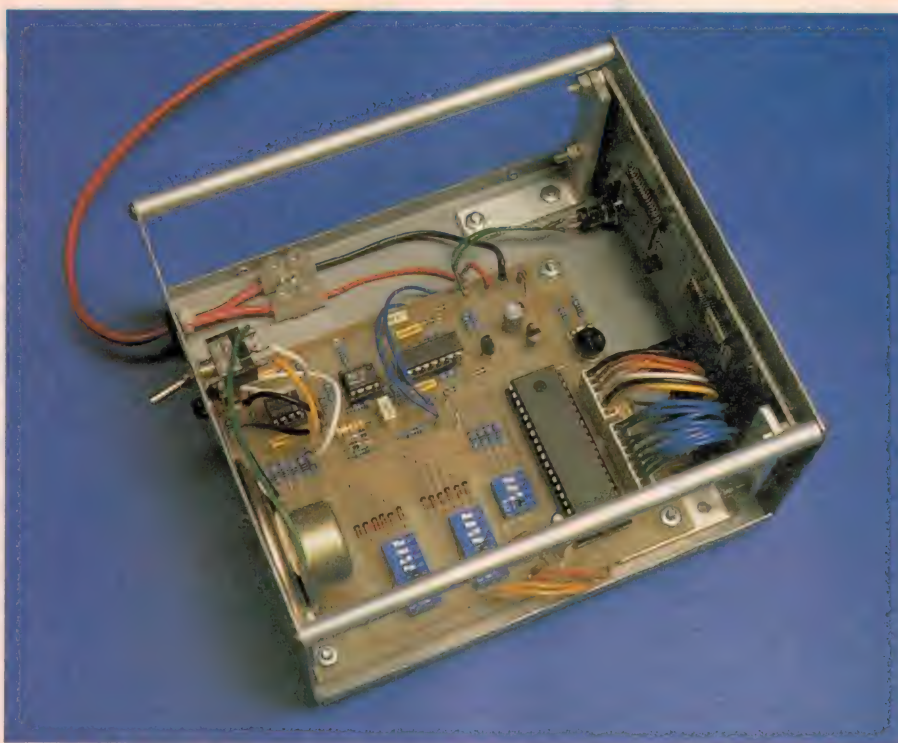
### Construction

The prototype of the clock was mounted in a metal instrument case measuring 130 x 140 x 75mm (WxDxH), which is about the minimum possible size. A larger size case would result in less of a squeeze. Should you decide to power your clock from the mains, there is room beside the PCB for a small transformer such as a 2851. An IEC power socket should be fitted in the back panel for this type of supply. If an external DC supply is used, wire a diode (1N4001) in series to prevent damage should the polarity be accidentally reversed.

I reinforced the front and rear panels by fitting 6mm aluminium rods between them at the top corners, secured with 3mm countersunk head screws which are screwed into tapped holes in the ends of the rods.

The next step is to mark out the rectangular hole in the front panel for the LCD. If the hole is carefully filed to the exact dimensions of the black metal escutcheon, it will protrude through by about 1mm and no further finish will be needed on the front panel, other than the label.

To avoid unsightly screws through the front panel, the display can be mounted on



*Inside the author's prototype. Note the brackets used to support the LCD display, and the rods used to brace the front and rear panels.*

two right angle brackets made from 12 x 3mm aluminium bar. The screws to hold the display pass through from the front side of the display circuit board, then through the bracket, with a nut acting as a spacer in between. The screw heads should be hard up behind the front panel when the right angle brackets are screwed to the bottom of the case with four more screws.

With a bit of juggling, I was able to position things so that one of these latter screws also became a support for one corner of the PCB. I then laid the PCB against the bottom of the case and drilled holes through for the other three mounting screws, thus ensuring accurate alignment. Other holes for switches, sockets and the speaker should also be drilled at this stage. I held the speaker in place using two clamps cut from 3mm thick aluminium, with one side rebated with a file by 2mm, to grip the outer rim of the speaker.

I made the front panel artwork using a technique described in *EA* in July 1997. The approach is to either photocopy the artwork given here, or produce your own on a computer, or by hand. Then cover the artwork with clear contact paper, and use wide double-sided tape to adhere it to the front of the case.

The LCD is connected to the PCB by 14 wires. These should definitely *not* be soldered at both ends, but rather the PCB layout provides for the use of two pin header sockets: one eight-way and one six-way. These are available from Jaycar and no doubt from

other sources also. The connectors slip over pin headers sticking up from the board. Use an assortment of wire colours to make tracing easier. The wires should be soldered to the display board before mounting it in the case. They are soldered in the same order as they emerge from the sockets.

The PCB is a single-layer board which can be produced using home equipment or purchased from companies who advertise in *EA*. Regardless of its origin, the PCB should be thoroughly inspected before mounting any components, to identify any bridged or open tracks.

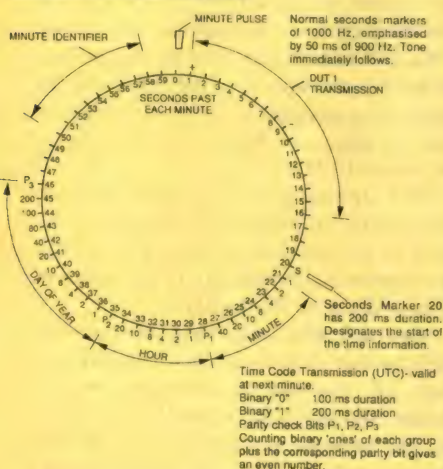
Commence the assembly of the PCB by installing four wire links as shown, followed by the PCB pins (16 in total), the DIP switches and the IC sockets. Next insert the resistors, capacitors and diodes, making sure the latter two are installed the correct way around. Leave the insertion of the IC's at this stage.

Only six of the DIP switches are used in the eight-way switch, and three are used on the four-way switch. The unused switches can be coloured with matching paint or a marking pen, to camouflage them; a similar treatment was used to delete the very misleading switch numbers printed on each switch.

Do a final check of all components, particularly those which require a particular orientation. Now you can mount the PCB on 3mm x 15mm screws using three nuts on each screw; one against the bottom of the box, one on the underside of the PCB and one on top.

### VNG TIME CODE FORMAT

Seconds markers normally 50 ms of 1000 Hz.  
Seconds markers 55 - 58 are 5 ms of 1000 Hz.  
Seconds marker 59 is omitted.  
Minute marker is 500 ms of 1000Hz.  
During the 5th, 10th, 15th, etc. minute,  
seconds markers 50 - 58 are 5 ms of 1000Hz.



**The time coding format used by VNG, using 1000Hz seconds pulses of varying length.**







## Self-setting VNG radio clock...

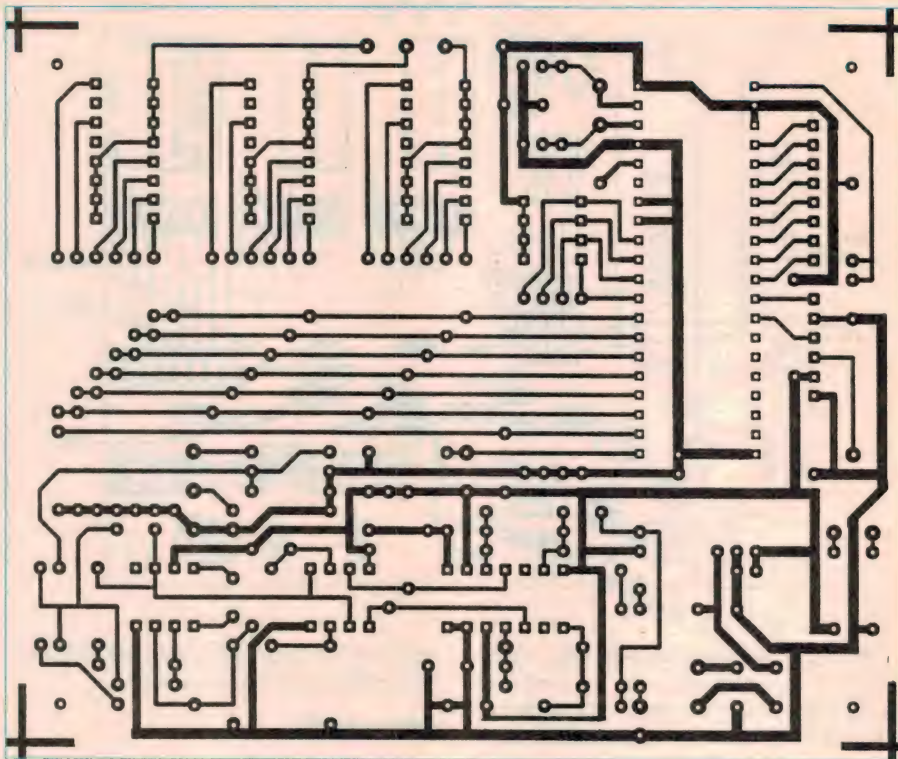
Here is the PCB etching artwork, reproduced actual size for those who like to etch their own.

present day as a digit between one and seven and display it as abbreviated text for the current day. For instance the setting for 1998 is 100, because 1st January occurs on a Thursday. If the bits on the DIP switch are all set to off, the feature will be turned off.

The Day of Week function is quite useful when selecting a time zone and wanting to know what day it is in that zone. The day number in the year is always shown in the lower right corner, for those interested in satellite work.

I used a three position centre-off toggle switch for the time zone selector. This gives me UTC and two other time zones. It is possible to install a rotary switch with more poles to give more selectable zones, but the PCB will only accommodate three DIP switches to select from. However it would be possible to construct your own extension board with more DIP switches and diodes on it to give more time zone selections.

Taken to the extreme, a 12-pole rotary switch, together with two toggle switches for plus or minus and half hour zones, could yield access to every time zone in the world. A diode array would have to be



designed for this as there would be little point in having DIP switches.

It matters not to the microcontroller how

many external selections you provide, so long as only one can be presented to port C at any one time. ♦

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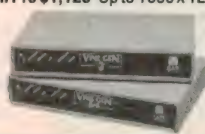
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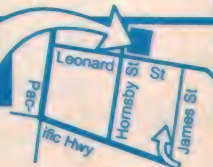
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# NEW BOOKS

## Windows NT4 reference

**WINDOWS NT WORKSTATION 4 UNLEASHED**, by Paul Cassel, Mike Sheehy and Sean Mathias. Sams Publishing, second edition 1997. Soft cover, 233 x 188mm, 930 pages. Includes CD-ROM disc. ISBN 0-672-31081-3. RRP \$99.95.

Having only recently upgraded myself to a Pentium II system running NT4, I found this book particularly interesting. It's another in the formidable Sams '... Unleashed' series, and continues their tradition of multiple authors collaborating to produce a whopping great tome on the subject concerned. This one has ended up with 37 meaty chapters and four data appendices, covering 930 pages, plus a CD-ROM with some useful NT software (including Executive Software's *Diskeeper Lite*, to provide something you don't get with NT: a hard disk defragger). The disc also provides two 'bonus books' in HTML form: one on troubleshooting and configuring the Win NT/95 registry, and the other on Teaching Yourself Microsoft Office in 24 Hours...

Needless to say it's pretty comprehensive, and generally seems to be quite well written and carefully edited. Comparing various sections with those in a couple of NT4 reference books I'd already bought when it arrived, it stacked up very well. The chapter on tuning NT4's performance (chapter 8) seemed to be particularly good, as is chapter 15 on using NT4's command line interface or 'virtual DOS machine' box. A couple of the appendices are also very helpful — especially appendix C, which explains much of the mystery surrounding Microsoft's crude and arcane system of Service Packs. Few such books are perfect, of course, and this one is no exception. Appendix D suddenly swings over to talk about the Server version of NT4 — presumably the result of slack editing.

On the whole, though, it's a very creditable reference on NT4 Workstation and would make an excellent addition to your library, if like me you're trying to master its operation. *Diskeeper Lite* seems to work well, too...

The review copy came from Prentice Hall Australia, of Locked Bag 507, Frenchs Forest 2086. (J.R.)



## Introductory servicing text

**ELECTRONICS SERVICING**, by J.S. Anderson. Butterworth Heinemann, 1997. Soft cover, 187 x 243mm, 278 pages. ISBN 0-7506-3554-1. RRP \$39.95.

This book is designed for students doing the UK City & Guilds 2240 course in Electronics Servicing (Part 1). This is for beginners to electronics, so although there's an emphasis on troubleshooting, it's really a text for those first learning electronics. It includes example questions as well as review questions and their answers.

It's divided into four parts, with the first covering the basics of electricity — basic atomic theory, the nature of

an electric current, voltage and resistance, and so on. Part two then looks at power supplies, tape recorders, AM and FM, speed control systems, phase-locked loop devices, the oscilloscope and the basics of colour TV (whew!). Also covered in their own chapters are digital electronics, amplifiers and oscillators, filters and wave-shaping, and transducers. The third part covers mathematics for electronics, and concludes with a chapter on safety. The last part is practical work, and presents a number of practical tasks that would normally be done in conjunction with the theoretical part of the book. The book is well illustrated and the writing style is easy to read.

The review copy came from Butterworth Heinemann, of PO Box 146, Port Melbourne 3207. (P.P.) ♦

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# LINE CARRIER LINK FOR HOME AUTOMATION - 4

Here's the fourth instalment in our series on building up a home automation system based on our Line Carrier Transmitter and Receiver units, as published in the November and December 1997 issues. This month we'll show you how to make a dual triac-controlled dimmer unit, which allows you to remotely control 240V AC lighting systems around the home.

by ROB EVANS

Having covered the ground work for adding expansion modules to the Line Carrier system in our last instalment (February 1998), we can now move on to a more ambitious add-on circuit — a dual, remotely programmable triac lamp dimmer module. This unit connects to the Line Carrier Receiver in the same manner as the quad output latch circuit described in the last instalment, and again is 'programmed' via the receiver's three data lines.

The dimmer unit can independently control two 240V AC lamp circuits via UP/DOWN commands from the transmitter, with the brightness level adjustable over 16 steps. In practice, the dimming level will move one step up or down with each (correct) mains-borne command signal, and can therefore move through its complete range when transmitter's button is held — remember that the transmitter circuit continuously repeats the current command, while the button is down.

As you can see from the shots of our assembled prototype boards, the dimmer unit is effectively split into two sections; the dimmer control module (the larger board), which processes the command signals from the Line Carrier Receiver, and the triac dimmer unit itself. Note that the control module can drive two dimmer boards, as its name implies, although only one triac board is shown in the photographs.

When it comes to including these modules in a practical setup, you will need to take a careful look at the case arrangement for the Line Carrier Receiver, since extra box space may be needed to accommodate the add-on units. The triac dimmer boards *could* be included inside the receiver unit if a larger case is used, but they would need to be electrically well insulated from the other circuitry — or even housed in their own plastic 'sub enclosure', for safety.

On the other hand, a more flexible arrangement may be to include the controller board inside the receiver unit, but

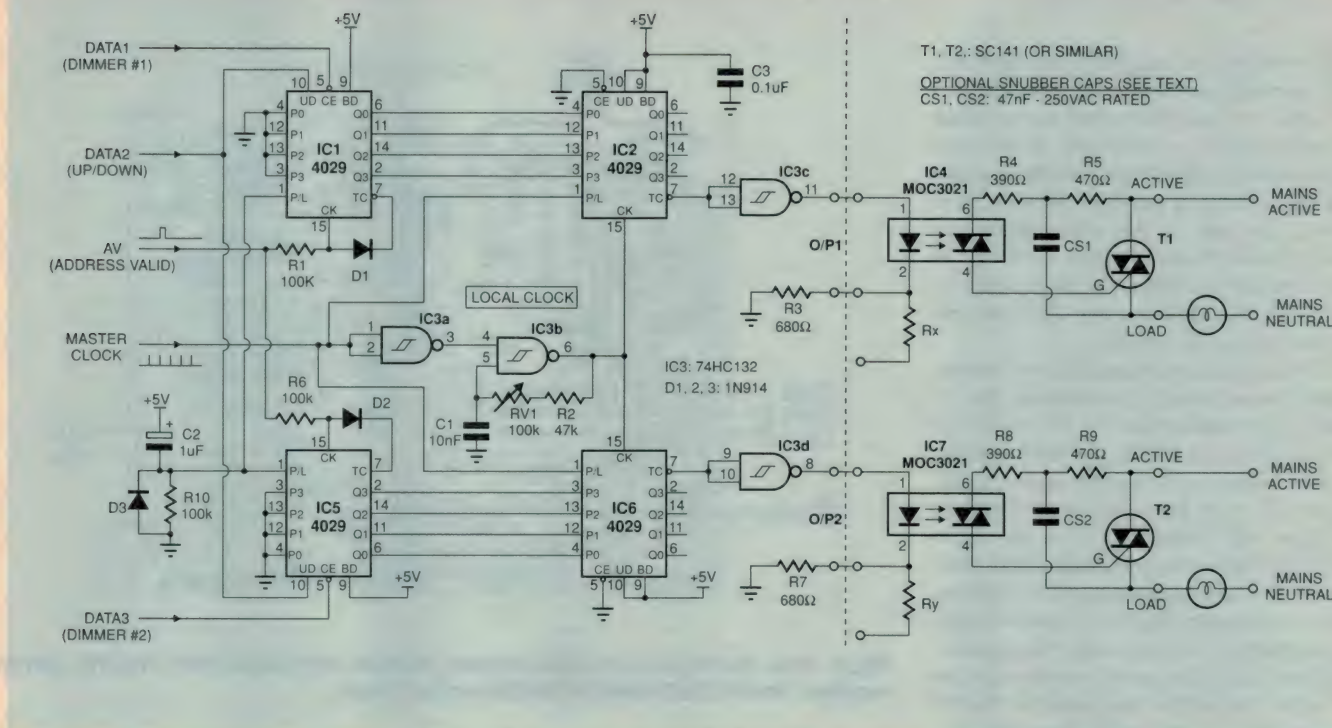


**The four basic 'add on' PCB modules described in this article and that of last month. At centre left is a triac switching module, with the dual-channel dimming control module at lower right.**

have the triac dimmer boards in their own separate, external enclosure. In this way the triac boards can be controlled by just four wires from the receiver unit, and the 240V AC wiring connected directly to the triac board. The triac box could even be installed in the house wall-space for example, so it can be wired directly into the existing lighting circuit — by a licensed electrician, of course...

Note that both Line Carrier units *and* the triac output board circuitry contain mains wiring at lethal voltage levels, and must be constructed in a safe manner with all exposed 240V AC connections fully covered. When wiring up the dimmer modules or transplanting the receiver board into a larger case, please refer to the relevant construction details in this article and those from the December 1997 issue.





**Fig.1: The schematic for the dual-channel dimmer, which is driven from the original line carrier receiver. As you can see each channel has its own opto-isolated triac switching.**

## Dimmer circuit

Fig.1 shows the schematic for our dual lamp dimmer circuit, which from a functional point of view can be split into an upper and lower half, where dimmer 1 is based on IC1-4 plus triac T1, while dimmer 2 is formed by IC5-7 plus T2. The remaining 'local clock' circuit based on IC3a and IC3b is shared by both dimmer circuits.

The circuit uses five control lines from the Line Carrier Receiver unit, which include the three decoded data lines (DATA1 to DATA3), the mains-synchronised master clock signal, and the Address Valid (AV) control line. Recapping briefly on the Receiver's operation, you may recall that the AV pulse will occur when the incoming address code (from the signals on the mains wiring) matches the receiver's hardwired address code. At this time, the

logic levels on the receiver's three data lines (DATA1-3) can be considered as valid, and can therefore be used to update or control the output circuitry.

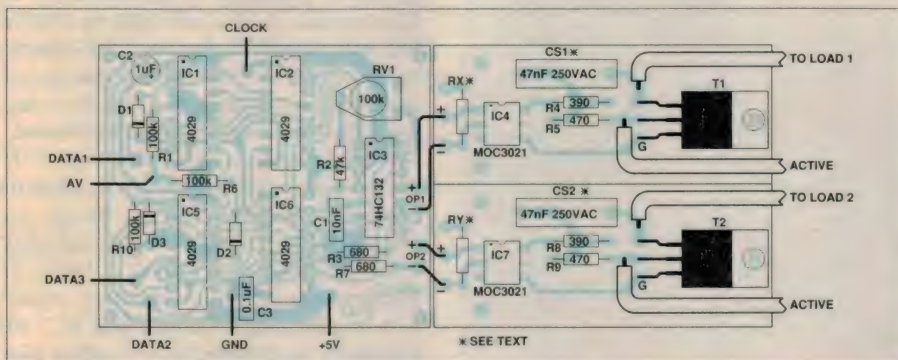
In the dimmer output circuit here, the three data lines are used to select which dimmer is to be controlled and in which direction the 'dimming' level will change (up or down), while the AV pulse instigates the action. As you can see from the schematic labelling, DATA1 selects dimmer 1, DATA2 determines the direction of change, and DATA3 is used to select dimmer 2.

The dimmer circuit itself is a little unusual in that it uses a (digitally) delayed pulse to 'fire' the triac, rather than the more traditional phase-shift techniques used in conventional dimmers. This triac-firing pulse is generated by a programmable delay circuit based on the 4029 counter IC2 (for dimmer 1), where its four-bit programming word (P0

to P3) is generated by the preceding 4029 counter IC1. This in turn is clocked up or down by the decoded commands from the Line Carrier Receiver unit, via DATA1, DATA2 and the AV pulse.

Looking at the circuit for dimmer 1 in more detail, the current dimming level data 'stored' in IC1 (as four bits) will be updated when DATA1 is low (IC1 selected) and an AV pulse arrives. If the DATA2 line is say high (the Receiver has decoded a 'dimmer UP' command), the AV pulse applied to IC1's clock input via R1 (at pin 15) will cause the counter to advance by one step. This causes its four-bit output code (Q0 to Q3) to increase by one, which is in turn used to update the programmable delay circuit (IC2). By the way, DATA3 would normally be high in this case, so IC5 (and consequently dimmer 2) will be ignored.

The four-bit code applied to the parallel (or jam) inputs of IC2 (pins 3, 4, 12 and 13) will then *preset* the counter to this value, when the next master clock pulse appears at its parallel-load input (pin 1). As this pulse occurs at each mains waveform zero-crossing point, IC2's four-bit 'dimming' delay value will be updated at the *beginning* of each mains half cycle.



**Fig.2: The component placement overlay for the dimmer boards, shown here as a single assembly. The triac boards would normally be separated from the control module, as the text explains.**



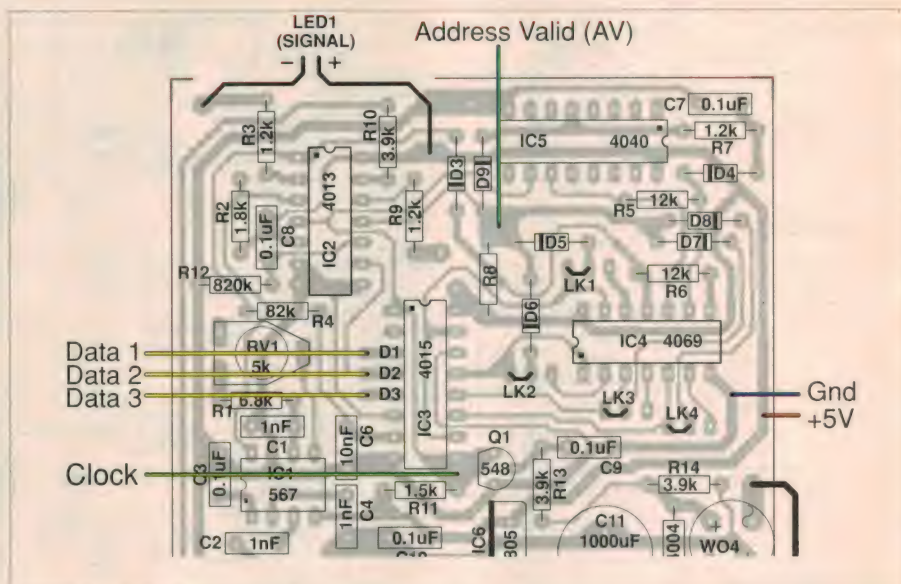
From the start of each half cycle then, IC2 will count up (pin 10 is high) from this preset value at a rate determined by the clock signal at pin 15 — we'll look at the local clock circuit shortly. If we consider a preset (dimming) value of say three (0011 at P0 to P3) for the sake of this explanation, then after a further 12 clocks cycles the 4029 will have reached its maximum count value of 15, where the terminal count (TC) pin will go low for one clock period.

The local clock is arranged to run at about 1.6kHz in our circuit, so in practice, this 12-count delay means that the TC pulse will occur 7.5ms ( $12 \times 625\mu\text{s}$ ) after the beginning of each mains zero-crossing point. As the mains half cycle has a period of 10ms and the triac will ultimately fire at the 7.5ms point, our delay programming code of three represents a correspondingly low dimming level — that is, the final 240V load will only be powered for 2.5ms in each 10ms period.

Moving on to the circuit's output stage, the TC pulse from IC2 is then passed to NAND inverter IC3c, which in turn drives the optoisolator IC4 (pins 1 and 2) via limiting resistor R3. When activated, the isolator's triac output stage (between pins 6 and 4) breaks down, thereby coupling the mains active line to the gate of triac T1 via R4 and R5. T1 then turns fully on, switching the 240V AC active line through to the load, as you would expect.

Note that resistors R4 and R5 are included to limit the transient current into the main triac gate, and also form a suitable triac snubber network when CS1 is installed. This is not really needed when the dimmer is controlling a resistive load such as a conventional lamp circuit, but may be necessary for more 'difficult' inductive loads or noisy mains supplies.

Resistor Rx is also included as an option-



**Fig.3: How the signals for the dimmer module are taken from the line carrier receiver board described in the December issue.**

al extra, and can be used when the triac output stage is coupled to circuits other than our programmable dimmer — they are usually separated, as indicated by the dashed line on the schematic. When the dimmer section is used elsewhere with a different drive voltage, IC4's input LED can be driven via a suitable value of Rx.

Returning to the local clock circuit in the main control section, you can see that this is based on a conventional Schmitt NAND gate oscillator stage IC3b, which is set to around 1.6kHz by C1, R2 and trimpot RV1. At this frequency there will be 16 clock cycles applied to IC2 during every mains half cycle, so the four-bit (16 possibilities) programmable delay will have the correct maximum

range of 10ms (16 x 625us).

Also, the local clock is synchronised to the mains zero-crossing points by the action of inverter IC3a, which will disable IC3b during each *master* clock pulse. This forces the local clock to restart at the beginning of each mains half cycle, thereby synchronising the programmable delay (IC2) to the mains waveform.

Another point of note in dimmer 1's circuit is the effect of R1 and D1 when IC1 reaches its maximum (or minimum count). If the 'dimmer up' command sequence used in the above example is repeated by a series of AV pulses — say, the UP button is being held on the Line Carrier Transmitter — IC1 will continue to count up to its maximum value (binary 1111), where the TC line pulls the cathode of D1 low. This in turn holds the 4029's clock input (pin 15) low, preventing further AV pulses arriving via R1.

The dimmer is now at its maximum level with full power applied to the load, and will remain in this state until the circuit is reset or a 'down' command is processed by the Receiver unit. In the latter case the DATA2 line will switch IC1 into its down-counting mode (pin 10 low), which immediately causes the TC line to return to a high level since the 4029 is no longer at its terminal count.

With the cathode of D1 now high, IC1's clock input is free to respond to incoming AV pulses via R1. As these pulses now correspond to 'dimmer down' commands from the Receiver (DATA2 is high), the 4029 counts down accordingly. Again, with repeated down commands IC2 will eventually be disabled by the action of its

## PARTS LIST

## Resistors

R1,6,10	100k
R2	47k
R3,7	680 ohms
R4,8	390 ohms
R5,9	470 ohms
Rx,y	see text
RV1	100k horizontal trimpot

## Capacitors

C1	10nF MKT
C2	1uF 16V electrolytic
C3	0.1uF MKT or monolithic
CS1,2	47nF 250VAC-rated (optional)

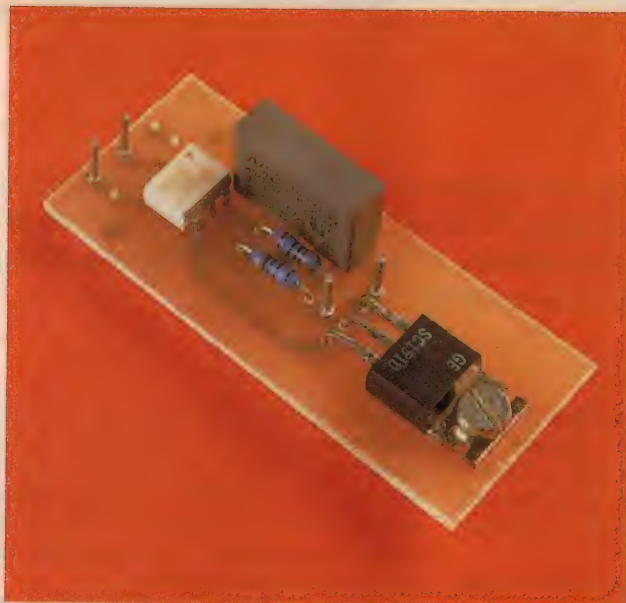
## Semiconductors

IC1,2,5,6	4029 four-bit up/down counter
IC3	74HC132 Schmitt input quad NAND
IC4,7	MOC3021 400V triac-output opto isolator
D1,2,3	1N914 diodes
T1,2	SC141 (or equivalent) triac

### Miscellaneous

PCB coded 98lcd1, 120 x 50mm; PCB pins, hookup wire.





**Close-up views of the triac switching PCB (above) and the dimmer control module (right), to help you in assembling your own.**

TC line (via D1), since the terminal count value is zero (0000) for the chip's down-counting mode.

Finally, the power-on reset circuit composed of C2, R10 and D2 applies a positive-going pulse to the parallel-load (P/L) input of the dimming level counter (pin 1 of IC2), which loads all zeros into the 4029 at power up. This corresponds to the maximum trigger pulse delay at IC2 (16 counts), so that the final output is initially off.

Note that the output will only be fully off if the triac trigger pulse is delayed by almost exactly 10ms — that is, it occurs at the very *end* of the mains half cycle. As the overall delay range is determined by the local clock frequency, RV1 needs to be set so that a zero count at IC1 corresponds to zero power in the output load. Alternatively, RV1 can be set for just a minimum brightness level, if this is preferred.

## Dimmer assembly

As shown in the dimmer unit component overlay diagram of Fig.2, the PCB can be split into three sections: the dimmer control section on the left, and two independent triac power control units on the right. For safety reasons the triac boards would normally be located in a separate insulated box, but again, this really depends on how you plan to install and use the receiver unit.

The complete dimmer board is coded 98lcd3, measures 119 x 50mm, and can be cut into two or three sections as indicated in the overlay diagram. Starting with the dimmer control board, fit all of the components while referring to the overlay diagram, and as usual, pay particular attention to the orientation of any polarised components.

The completed dimmer board can be installed inside the existing Line Carrier Receiver unit with the output leads (OP1 and OP2) passing to a separate triac control unit, or the whole assembly installed in a dedicated larger box, as a 'smart' dimmer unit. In any case, the triac boards must be assembled as shown in the overlay, while keeping the safety aspects clearly in mind — remember that there are lethal voltage levels on the PCB and components, including the triac's metal tab.

Other than that, if the triac board will be driving a relatively heavy 240V AC load (say, more than a couple of hundred watts) you will need to fit a heatsink to the triac tab, and if an inductive load is likely the snubber capacitor (CS1) should be installed. The triac heatsink will also be at mains potential by the way, so take care here as well.

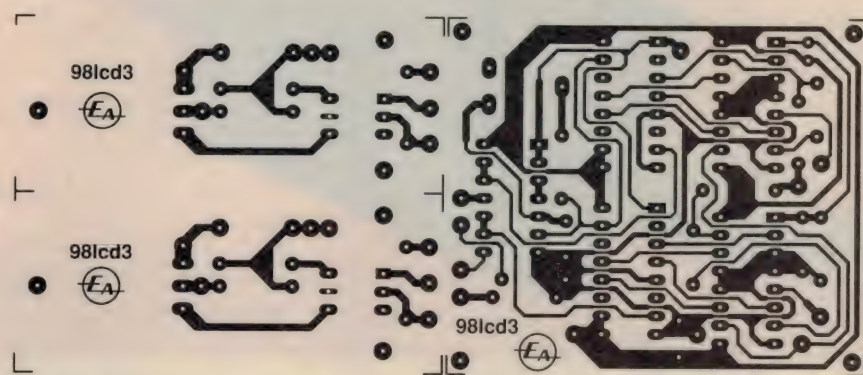
## Receiver changes

The dimmer controller board is connected to the Line Carrier Receiver unit in the same

manner as the quad latch output board described in the last instalment (part three). The DATA1 to DATA3, AV pulse and 5V supply leads are tapped off the receiver's circuit board on the copper side of the PCB, or via PCB pins in a conventional way.

This process was covered in some detail in the last installment (February 1998), and we'd strongly recommend that you refer back to that issue when connecting the dimmer control module to the receiver unit. To aid the process though, we've included the receiver connection diagram from that issue as a guide — see Fig.3.

Lastly, with all of the connections made and the complete unit up and running, the dimmer's local clock oscillator trimpot RV1 can be adjusted for a suitable minimum output power level. With a lamp connected as the 240V load and the dimmer unit set to its minimum level (say, the initial reset state), RV1 can be adjusted so that the lamp is just off — or at a very low brightness. ♦



**Fig.4: Here is the etching artwork for the triac and dimmer control PCBs, reproduced actual size for those who etch their own.**



# THE 'CAPS CATCHER'

Here's an innovative little project which should really appeal to those who are less-than-totally-confident typists. It's a nifty little box which connects between your PC and its keyboard, and 'sounds an alarm' when you have accidentally hit the 'Caps Lock' key instead of the 'A' — resulting in a string of unwanted capitals. You can build it very quickly from a low-cost kit.

by **MARK BEATTIE** and **JOE RAINE**

HAVE YOU EVER SUFFERED THE FRUSTRATION OF FINDING MOST OF THE LAST LINE OF TEXT YOU CAREFULLY TYPED IS IN UPPER CASE? If this happens to you, then this project will help to make using your computer a bit less annoying — and perhaps clear the air in your vicinity of a few expletives every day. With a tiny number of components, it is easily assembled and provides an audible alarm to warn you that you are typing capitals.

The Caps Catcher sits between your computer and the keyboard, and monitors the serial data sent between the two — producing an audible alarm if three consecutive capitals are typed. By a press of the button on the Caps Catcher this can be changed to 30 capitals, or it can be turned off completely. The design presented here has been tested on several PCs, ranging from a 12MHz '286 to a 133MHz Pentium and with DOS 6.22, Win 3.11 and Win95 OSR2. PS2s were not available for testing, but as far as we know, should work OK — though adaptor cables will be needed. The unit will not work on an XT as the keyboard interface is different.

When we commenced this project, we knew that it would be only be achieved by

using a microcontroller to process the data. But which microcontroller? Initially, we conceived a hybrid circuit with a CMOS shift register to convert the serial data into parallel form, to be presented to whatever microcontroller we used.

To keep the component-count low and the physical size small, it soon became obvious that whatever device we chose would have to have this capability built in; so we looked for those with edge-triggered interrupts. They were too pricey, so we decided to settle on a cheap, easily obtainable device, the PIC16C54-HS/P and force it to do our bidding. We had many highs and many lows, and a long abstinence before ultimate success, but at the end of it all we think we have a 'bulletproof' application.

Projects containing microcontrollers and other programmable devices are generally cursed either by secrecy or the bulky, boring nature of their source code. We hope to change that with this and our future microcontroller projects. The source-code and hex data files will be freely available to the private experimenter, but don't expect to see them in print — it is not a good read. We encourage the home constructor to experiment with the

firmware and we hope that you will share your experiences freely with everyone. In our opinion, there is nothing worse than a project which uses a programmed device for which the data is kept a total secret. There is no incentive or possibility for the experimenter to learn from such an approach.

Having said that, this is not an open invitation for any person or organisation to profit from our code. Individual constructors are welcome to make as many units as they need for their personal use, but no manufacturer or reseller may sell any equipment or components containing all or any part of our code without our prior, written permission. The code is our original work, is subject to copyright and will remain our property. The various 'PIC chips' as they are affectionately known, have a strong presence on the internet and any search engine will find heaps of sites with information, circuits and code available for download.

## Fast & flexible

The PIC16C54-HS/P was chosen for this project because of its high speed and flexible I/O capabilities, and because it is cheap and popular. Although it lacks interrupts, which would allow edge-sensitive detection of the serial data, it executes most of its instructions in only 500ns (half a microsecond) when using a 8MHz clock, which we found to be fast enough to reliably catch a pulse as narrow as 2us. It has only 33 instructions, 512 bytes of ROM for the program, 25 bytes of RAM for temporary data storage and 12 I/O pins, all of which can source 20mA or sink 25mA, with a combined maximum of 150mA at any one time.

The most difficult problem to overcome in this design was decoding the keyboard and PC data. Ideally, all we needed to do was to read the ASCII codes for the A-Z keys and then count them; but unfortunately it was not so simple. The keyboard tells the computer which key has been pressed by sending it a packet of data containing the key's 'scan code'. The scan codes correspond to the key's position in the keyboard switch matrix, not the corresponding ASCII code, so the list of codes for the alpha characters is not consecutive. Capitals are no different to lower-case characters as far as the keyboard is concerned.



*Here it is, only a little smaller than actual size. It's powered from the PC itself, via the keyboard cable, and can be set to 'beep' after either three or 30 consecutive capital letters.*



**Fig.1: At the heart of the circuit is a pre-programmed PIC16C54 microcontroller, constantly examining the codes returned from the keyboard...**

Caps Lock is only toggled in the computer, which then tells the keyboard what state the three 'Lock' LEDs should be in. This ensures that the state of the Caps Lock function and the Caps Lock LED will always match.

Serial communications between the keyboard and computer are synchronous, consisting of two separate signals — one containing the data, and one providing a clock with which to read the data. It is also bi-directional (open-collector drive), meaning both devices can send and receive data to each other on the same line. Just which device happens to be sending data is determined by the way the clock and data lines change when a transmission begins.

This requires the firmware routines that read the data to be able to recognise which device is transmitting, and to decode it accordingly. Accurate information about the data protocol was difficult to find when researching for this project — there is a lot of misinformation and hearsay available from the Internet. Much of our information came from actually monitoring the data on a Tektronix TDS220 digital oscilloscope (love that CRO!).

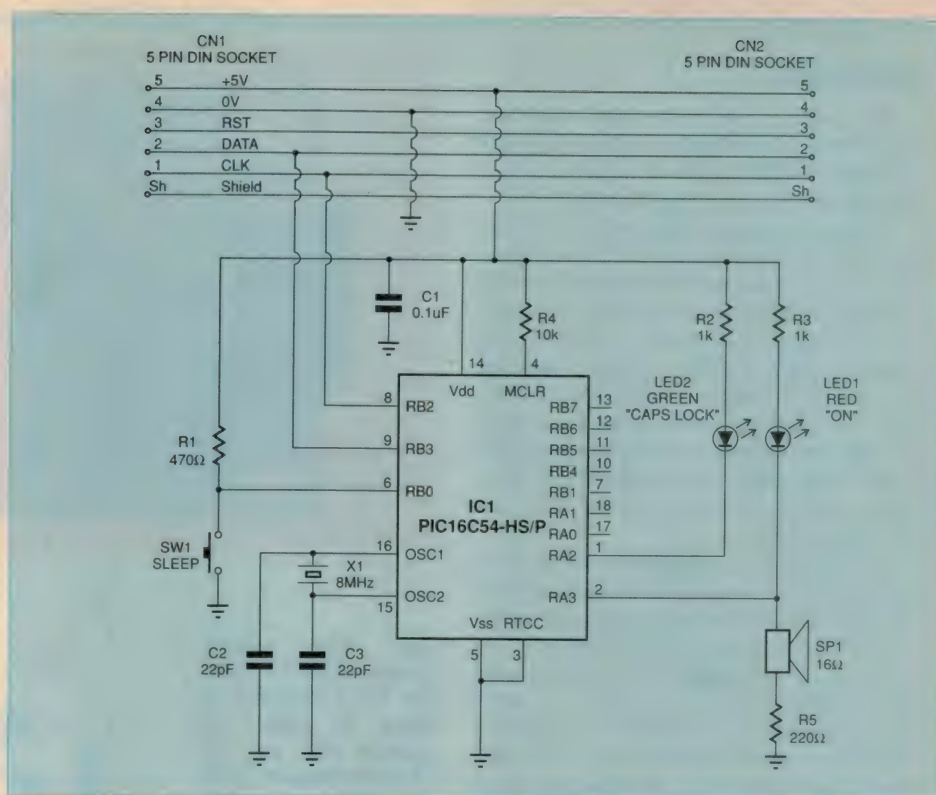
When you turn on your PC, commands travel to and from the keyboard to see if it is present, working correctly, program the typematic rate, set the LEDs, check for stuck keys, etc. All this stuff has to be ignored by the Caps Catcher, which patiently waits for something it can 'understand'.

It is because of the complex nature of the keyboard/PC communications that a simple concept grew complicated. The keyboard interface was never intended to have any additional device/s attached to it. To understand how the Caps Catcher works, you will need to get the source code and read the comments in conjunction with this description — whilst also referring to the circuit diagram (Phew!). The following description should give you a pretty good idea of how it works, though.

Two five-pin DIN sockets are connected in parallel to allow the Caps Catcher to be inserted in the keyboard line. Power for the circuit is obtained from pin 5, which carries +5V, and pin 4 which is 0V or ground. This supply is filtered by a C1, a 0.1uF monolithic block ceramic capacitor, placed as close as possible to IC1.

Pin 3 on the keyboard line is Reset, a throwback to the old XT keyboards which is not used with AT keyboards and which is not used here. Pin 2 carries the data to/from the keyboard and PC, and is connected to pin 9 of IC1. Pin 1 is the all-important clock signal and it is connected to pin 8 of IC1.

X1 is an 8MHz crystal which is connected to the PIC's internal oscillator circuit on pins 15 and 16. C2 and C3 are 22pF ceramic NP0 capacitors required for proper operation of



the crystal oscillator. Pin 4 of IC1 is the reset pin, which is not used directly in this application, but which needs to be tied to +5V for normal operation. This pin must not be directly connected to +5V as there is an internal reset circuit which would be damaged if it tried to reset the processor, so R4, a 10k resistor is used.

Two LEDs provide visual indications of circuit status. LED1, a red LED is used to indicate that the unit is ON and active. R3 limits LED1's current to about 3mA when pin 2 of IC1 is low. When a 'beep' is required, pin 2 is taken high and low at 4.4kHz. This approach was taken even though there are plenty of spare ports on IC1 because it would take extra code space to use a separate port and it would also slow down the execution of the firmware. Pin 2 of IC1 goes and stays high when the unit is disabled, so there will be a steady current of approximately 20mA through SP1 in this condition.

LED2 is a green LED, used to indicate the status of Caps Lock and to blink when the unit is in its reduced sensitivity '30 Caps' mode. R2 limits LED2's current to about 3mA.

SW1 is a miniature momentary-action pushbutton switch, used to control the Caps Catcher. It is connected to 0V and pin 6 of IC1, which is also pulled up to +5V by R1 (470 ohms) — which will allow around 10mA to flow through the switch contacts to keep them clean. Pin 3 of IC1 is used for an external clock and is held at 0V for proper operation in this circuit. All unused pins of IC1 are left floating as they are not enabled in the firmware and have no function other

than to mechanically support the chip.

The keyboard Clock and Data lines are sampled at high speed. When a change in level is detected on either, the logic programmed into IC1's firmware determines whether the PC or the keyboard is sending data and then decodes the data appropriately. The data is intended to be read on the leading edge of the clock signal, but high-speed sampling is the closest you can get to edge-triggering without edge-sensing circuitry. This technique works reliably and has proved to be more than adequate for the task at hand.

The firmware watches for the caps-lock code from the keyboard and the subsequent keyboard LED code (the Num Lock, Caps Lock and Scroll Lock LED status are sent as a single byte) from the PC, and mimics the keyboard's Caps Lock LED. This ensures that LED2 will always match the true caps lock status.

When caps lock is on, the program watches for the 26 alpha codes from the keyboard and counts consecutive ones. If a count of three is reached, pin 2 is turned on and off at 4.4kHz (the resonant frequency of SP1) for about 200ms, thus causing SP1 to beep and warn the user that perhaps they are typing capitals when they don't mean to.

There are some other 'housekeeping' aspects of the program that deal with unwanted 'rogue' pulses, and detecting various reset and startup codes that will not be discussed here. They are necessary to ensure that the Caps Catcher will work reliably with as many PC and keyboard combinations as possible. That concludes the description of the circuit.



## Assembly

We suggest preparing the ABS utility box first. There are several holes to be drilled, and a couple of them need to be enlarged before the box can be used to support the PCB.

The easiest way to mark out the box is to use the 1:1 templates supplied as part of the kit. First, cut them out, then temporarily hold the end one against one end of the box using a flat surface to ensure it is aligned and straight. Using a scribe, compass point or centre-punch, make a mark through the paper to mark the centre of the large hole. Repeat this for the other end. Next, mark the sides in the same way using the side template. Note that both sides are the same and both ends are the same.

Now place the top template inside the box, making sure it is straight. Mark the three holes for the LEDs and the switch in the same way.

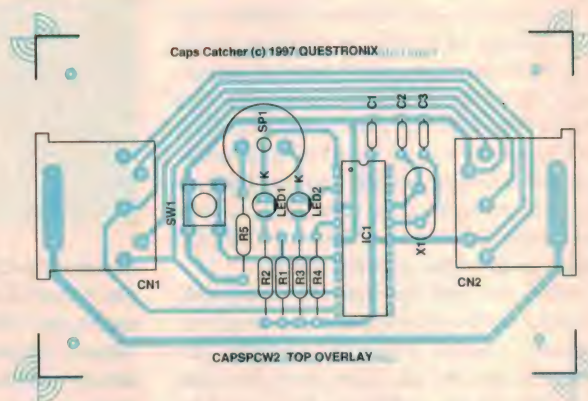
It will now be easy to drill the holes. Use a low speed or the plastic will melt and stick to the drill, causing a poor finish. To make the 18mm-diameter end holes, we used a 4-12mm step drill which cuts its way with vertical flutes rather than a spiral and therefore does not place any stress on the plastic. The resulting 12mm holes were then easily reamed out to 18mm. A hole saw could also be used, or you may elect to use a round file.

If you are going to file, scribe the outer diameter of the hole with a compass before drilling the centre hole and screw the lid back on before filing, or you may crack the end panel/s.

The next task is to extend the button on SW1. A piece of perspex rod is included in the kit. To prepare a 20mm length, cut it slightly longer than this and then using a fine file or some abrasive paper, clean the ends and make them flat. Place a small blob of Silastic RTV (we used clear) on the switch; it doesn't matter if it goes all over the top of the switch as Silastic won't run and it won't affect the switch. Now smear some Silastic at one end of the perspex rod and push that end into the blob on the switch. Centre it and form it up a bit with a screwdriver if you like, but note that Silastic is sticky stuff and difficult to make neat. Now put this little assembly in a vice with the switch upper-



**Use the photo above, together with the PCB overlay in Fig.2 at right, to ensure that you fit all components with the correct orientation. Pushbutton switch SW1 is fitted with a small extension rod.**



most so that the Silastic will set and hold the rod onto the switch's pushbutton.

Before assembling the components on the PCB, look at it carefully and admire the absence of shorts, scratches, broken tracks or any other faults. The circuit board we provide in our kit has the component overlay printed on it, to make life easy for you.

It is best to insert the lowest components, such as resistors first, solder them in and then progressively add the taller ones. The PIC chip is CMOS, so take precautions against electrostatic damage and solder pins 5 (0V) and 14 (+5V) first to enable the on-chip ESD (electrostatic discharge) protection.

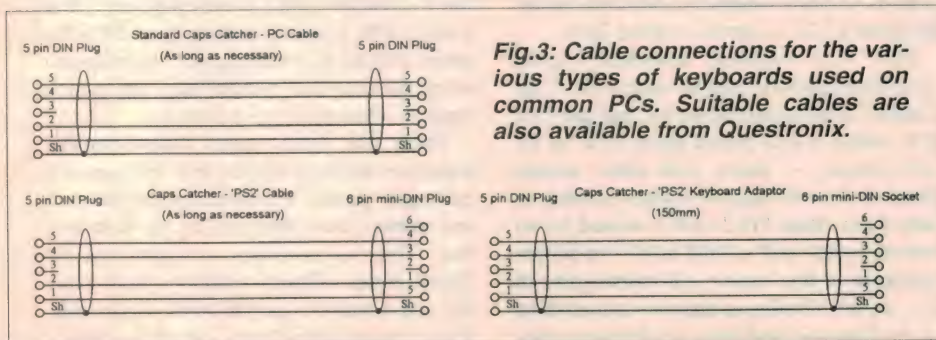
Care should be taken when handling SP1. The attachment of the legs to the minuscule PCB inside can be a tad fragile, so solder its

pins quickly to avoid melting the solder which holds them.

When attaching the five-pin DIN sockets to the PCB, solder the central pin before soldering the rest. This pin can then be carefully heated to allow the connector to be pushed flush against the board. Be careful though not to apply any force before the solder on that pin has fully melted, as the pad could be pushed off the PCB. It is important that the connectors are mounted down flush because the soldered connections have to be well supported, to withstand the considerable mechanical force of the plugs being inserted and extracted.

Solder SW1 to the PCB, but don't solder the two LEDs yet; just put them into the board and let them dangle. Remember to observe the orientation of the two LEDs. They won't be damaged by reverse connection, but they won't light either and the whole project will look 'dead'. The cathode has a shorter pin than the anode; its hole in the PCB is marked by having a rectangular pad on the solder side of the PCB, and on the component overlay with the mystical symbol 'K' (which harks back hundreds of years to the ancient days of Gothic electronics, when they spelt it Kathode to confuse acolytes and keep the unwashed hordes ignorant of the new magic).

Now insert the PCB into the box by lowering the box over it. Guide SW1's extension



**Fig.3: Cable connections for the various types of keyboards used on common PCs. Suitable cables are also available from Questronix.**



through its hole, and then make sure the PCB is into the box as far as it will go; it's a neat fit. SW1's extension should be poking out about 2mm. Now, without turning the box over, grasp the legs of one LED, push it up and fish about for its hole (it's easy); then hold that one in place and do the same for the other one. Now you can turn the box over!

If you want the LEDs to poke out, keep the box off your work surface whilst soldering the leads; if you want them flush let it sit on the surface whilst the perspex extension dangles. Make sure the PCB is still all the way into the box before soldering the LEDs. Cut off any long pins, etc. and put on the lid using the screws provided. Voila — it is done!

## Testing

You will need a five-pin DIN cable (male to male) about 1.8 metres long to use with the Caps Catcher. You can make one yourself or buy them already made up. If making your own, make absolutely sure that it is 1:1 — that is, pin 1 goes to pin 1, pin 2 to pin 2 etc., and that there are no shorts between pins or to the shells.

By the way, don't be tempted to use a hifi-type DIN cable; pin 2 is likely to be connected to the screen/s, and as this line is used for keyboard data, it may cause RFI. Some hifi DIN cables also have the pin 4/5 connections crossing over — which would produce disastrous results here!

Plug the cable into one end of the Caps Catcher and the other end into the PC's keyboard port. Plug the keyboard's cable into the other socket on the Caps Catcher and turn on the computer. The keyboard's LEDs should flash as normal when the computer boots up and the Caps Catcher should turn LED1 (the red one) on as the computer initialises.

If this does not happen, calmly turn the computer off, disconnect and dismantle the Caps Catcher and proceed to double check the board for solder bridges, unsoldered pins or incorrectly inserted components. Check your cable too.

If the Caps Catcher bursts into flames

and/or your PC fails to boot, it is likely that you have made a rather serious error somewhere along the way. Recovery from this scenario is beyond the scope of this article, but we suggest that the PC is turned off as soon as possible...

If all is well, and this should definitely be the case, when the computer and keyboard have successfully finished exchanging data, the Caps Catcher will keep the green (Caps Lock) LED off, and leave the red LED on. This happens around the same time as the computer beeps and starts to load the operating system software. When the PC has finished booting, press Caps Lock and check that both the keyboard and the Caps Catcher indicate that it is on. The unit is able to be inserted into, or removed from the keyboard line with the computer running, though why you should want to do this may not be abundantly clear. Perhaps you are using a switch box to share one keyboard with two computers (more about this in a future project). We suggest that you keep the keyboard plugged into the Caps Catcher so that both will power-up at the same time, though either way will work.

The keyboard will be reset by disconnecting and reconnecting its power and interrupting its Clock and Data, so the first time Caps Lock is pressed, it is normal for the computer to tell the keyboard to turn Num Lock and perhaps Scroll Lock on. Caps Lock may be on or off, depending on what state it was in before the keyboard was disconnected, and the Caps Catcher will automatically synchronise itself with the state of the Caps Lock LED on the keyboard.

With the Caps Catcher running properly, it can now be put into use on your computer desk where it will serve you well for many years. In our testing, we were unable to confuse it, even when pressing random keys as quickly as possible with Caps Lock on and the alarm beeping frequently.

The beep made by the Caps Catcher is subtle, as we did not want to annoy you or those around you. If you want to type some capitals without the constant reminder, just press the

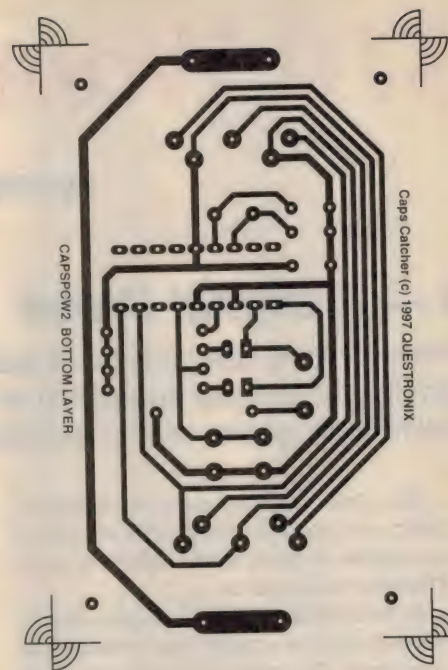
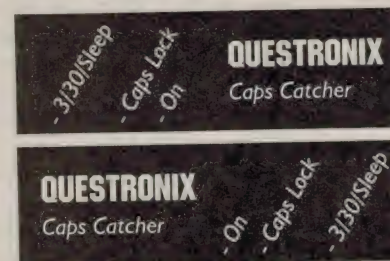


Fig.4: Actual-size artwork for the PCB and front panel (below, two versions).



little button once and the green LED will flash to tell you that it is in '30 capitals' mode. It will beep every 30 capitals no matter what is typed in between. Press it again and it is back in '3 capitals' mode. It will beep for every three consecutive capitals.

Press the button for a second or more, and Caps Catcher will go to sleep with both LEDs off and no beeps — whether you are typing with Caps Lock on or not! Press it again and it will spring to life in '3 capitals' mode, the normal power-on default.

You can't put the unit in '30 capitals' mode if the Caps Lock is off, but you can put it in Sleep mode. If it is in '30 capitals' mode and you toggle Caps Lock, the unit will come back in '3 capitals' mode.

Typing capitals with Caps Lock off and using the Shift key will not cause the Caps Catcher to beep. We feel that you should already be aware of the fact that you are holding the Shift key down!

The Caps Catcher will beep if Caps Lock is on and you are holding down the Shift Key, thus actually typing lower-case characters, but we did not see this 'inverted' condition as worthy of a swag of extra code. This all seems logical to us, but let us know your thoughts. ♦

## PARTS LIST

### Resistors

R1	470 ohms
R2,3	1k
R4	10k
R5	220 ohms

### Capacitors

C1	0.1uF monolithic
C2,3	22pF NP0 ceramic

### Semiconductors

LED1	3mm green LED
LED2	3mm red LED
IC1	Pre-programmed PIC16C54-HS/P

### Miscellaneous

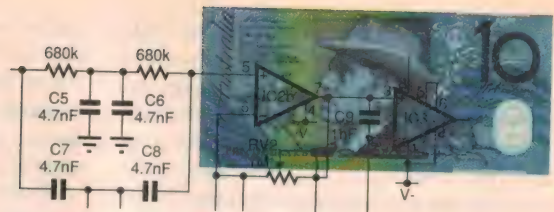
CN1,2	PCB-mounting 5-pin DIN socket
SW1	Tactile pushbutton switch, PCB mounting
X1	8MHz crystal
SP1	Mini speaker, 16 ohms

PCB	79 x 50mm, coded CAPSPCW2
Box	83 x 54 x 30mm, ABS (UB5 size)
Perspex rod,	3.3mm diameter x 25mm, clear; blob of Silastic RTV (not supplied in kit).

Complete kits of parts for the Caps Catcher project are available from Questronix, of 2/1 Leonard Street, Hornsby NSW 2077; phone (02) 9477 3596. The price for the kit is \$29.95 plus \$8.00 for Express Postage within Australia. Assembled, tested and guaranteed units (option ATG1) are available for \$10 extra. Two-metre long cables fitted with 5-pin DIN plugs at each end are available (code CK52PP) for \$11.95; 5-pin DIN socket to 6-pin mini plug adaptors (CA5S6P) for \$4.95; 5-pin DIN plug to 6-pin mini socket adaptors for \$4.95; 5-pin DIN plugs, solder type, for \$0.85; and six-core shielded data cable for \$1.20 per metre. All of the above plus \$8.00 postage if applicable. Also available are blank (i.e., unprogrammed) PIC16C54 microcontroller chips.



by OWEN BISHOP



## 8 — A Digital Probe

This is a handy device to have ready on the bench for checking out digital projects. It takes its power from the project you are testing, so there are no problems about supply voltage levels. It is built with CMOS logic gates, so it is automatically set to respond correctly to CMOS outputs.

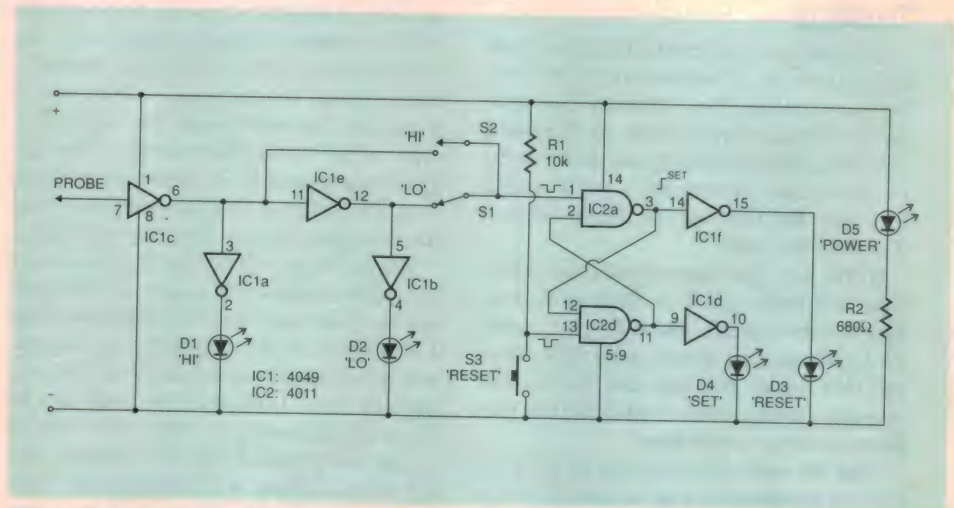
This device has two modes of operation, Static and Dynamic. We'll start off with a description of Static mode, and move on to Dynamic mode later on.

In Static mode the probe indicates whether the test point is at a steady high or steady low logic level. The probe is wired to one of the inverting buffer gates of IC1 (a 4049), which is in turn wired to three other inverting buffers, as shown in Fig.1. When the probe is touched against a point in the test circuit which is at logic LOW, pin 7 is low, pin 6 is high, pin 3 is high and pin 2 is low — so light-emitting diode D1 is off. At the same time pin 11 is high, pin 12 is low, pin 5 is low and pin 4 is high, so D2 is on. This is the LED labelled 'LO', indicating a low input.

When the probe input is at logic high, all of the logic levels are the reverse of those listed above. So this time D2 is off, but D1 is on. The 'HI' label on this LED indicates logic high.

The logic of this part of the circuit may seem unduly complicated, but it is better that the gates which detect logic levels are not the same gates that drive the LEDs. If you measure the voltage at pin 2 of IC1 when D1 is on, you will find that it is not at logic high. With a 6V supply, its output voltage is dragged down to only 2V or 3V by the relatively high current through the LED.

For steady logic levels, either D1 or D2 is



**Fig.1: LEDs D1 and D2 indicate a high or low logic level on the probe's input, while either D3 or D4 will latch on when the probe detects the logic level selected by S1 and S2. The 4049's internal current limiting means that we don't need dropper resistors for the four main display LEDs.**

on and the other one is off. If the level is alternating at up to 10 or so times per second, the LEDs flash alternately, like the warning lights on a railway crossing. This is easily recognised and interpreted.

## Dynamic mode

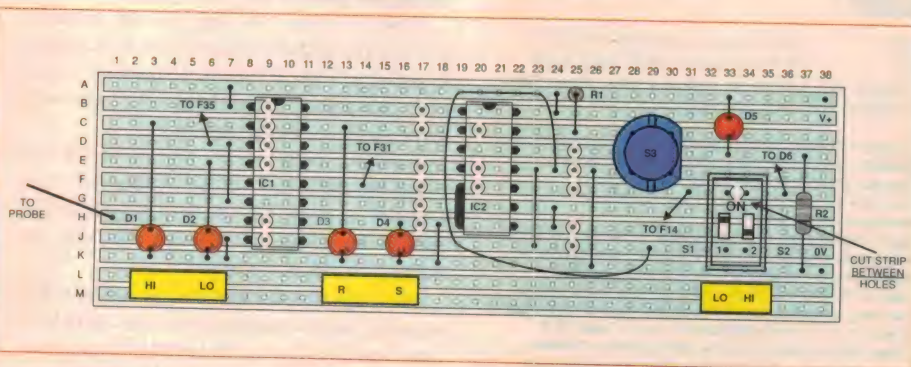
There can be difficulties, however, in interpreting some other possible logic

sequences. If the level alternates more rapidly, say more than 20 times a second, the eye is not able to detect the flashes and we see a more-or-less steady intermediate level of brightness on both LEDs. This could also be caused by a 'floating' input hovering midway between the +V and 0V supply lines, or by shorts or open-circuits in the circuit under test (particularly by either the +V or 0V terminals of an IC being left unconnected, so that the chip is obtaining its supply through one or more of the logic inputs or outputs).

To distinguish between a floating output and a genuine rapidly alternating one, we use the probe's Dynamic Mode.

The circuit for this is a set/reset flip-flop consisting of two cross-connected NAND gates (IC2, a 4011). Normally the two inputs to this are held at logic high and a brief low pulse to one or the other of these causes the flip-flop to change state, if it is not in the appropriate state already.

Suppose that the flip-flop is already 'set'. The output at pin 3 is high and the other output, pin 11, is low. Allowing for the invert-



**Fig.2: The component overlay for the Logic Probe. Note that two jumper wires need to be connected to the points marked, and that the copper strip needs to be cut between the top two pins of S1/S2.**



ing buffers that drive D3 and D4, this means that D3 is dark and D4 is glowing (indicating 'set'). Pressing the reset button S3 makes input pin 13 low, bringing pin 11 high. The two high inputs at pins 1 and 2 now make pin 3 go low, keeping pin 12 low so pin 11 will stay high whatever happens to pin 13.

In this way the flip-flop has been reset. D3 comes on (indicating 'reset') and D4 goes out. Pressing S3 again has no more effect, but a low pulse applied to pin 1 will set the flip-flop again. We use this action to detect any brief low level signal at pin 1.

Pin 1 of IC2 can be connected to pin 6 or pin 12 of IC1. These give a low pulse when there is a high (pin 6) or low (pin 12) input pulse at the probe. S1 and S2 are used to select the kind of pulse we want to register. If we are simply looking for a rapidly alternating input level, it does not matter which one we select.

One useful thing is that Dynamic mode can also detect a single brief pulse, acting as a pulse-stretcher or latch to make it possible to observe logical events that are too short for detection by eye. For example, to detect a low pulse from an output that is normally high, we close S1. Then we press S3 to reset the flip-flop (D4 on). The flip-flop changes state (D3 on) immediately a low pulse is detected. Pressing S3 again resets the flip-flop ready to detect the next low pulse. For detecting high pulses, simply open S1 and close S2. Press S3 as before to put D4 on. D4 goes out and D3 comes on as soon as a high pulse is detected. (Note that S1 and S2 shouldn't both be on together for a prolonged period of time.)

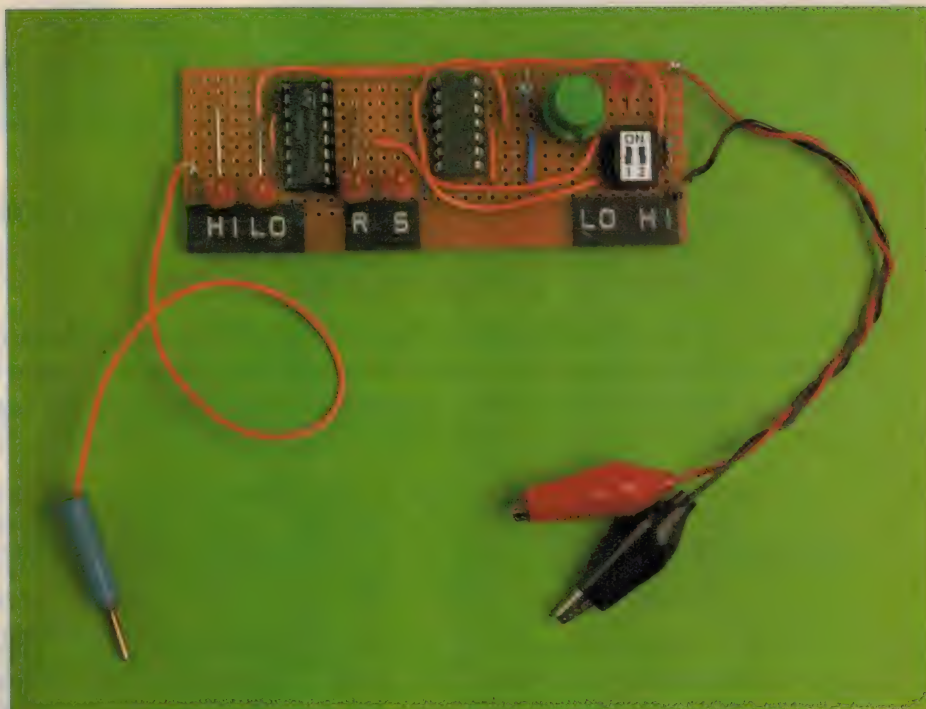
## Construction

The circuit is built on a narrow rectangle of strip-board with the probe at one end and the power leads at the other. You may find a narrow case to hold this, with apertures cut for viewing the LEDs. Or you could enclose it in a Jiffy box, mounting the switches and LEDs on the lid of the box, with leads to the circuit board inside.

We used a 1.5mm plug for the probe, connected to the board by flexible wire about 10cm long. You may prefer to make a probe from stiff bare wire, fixed rigidly to the board so that you hold the whole assembly in your hand as you probe the test circuit.

Another type of probe connector that you could use is a test clip. This has a spring-loaded hook that can firmly grip any bare wire or integrated circuit pin. A clip is more suitable when you want to monitor the level at one particular point for a period of time. The narrow plug is better for quickly checking levels at many points in the test circuit. The two power supply wires, also about 10cm long, end in crocodile clips or test clips.

We used a dual DIL switch for S1 and S2,



*The completed logic probe. We used a pair of alligator clips to connect the probe to the circuit under test. The probe could be replaced with a mini test clip if desired.*

because it is smaller and cheaper than most other types, but if you are mounting the switch on the lid of the enclosure, any type of small SPDT switch will serve in place of both S1 and S2.

Note that you will have to cut the strip between the holes at F33 and F34. Do this with a sharp craft knife, or use a miniature circular saw in a mini electric drill. Also note that the copper strips are NOT cut at H20 and J20, and that they're not cut at G9, D17, D20 or E20 either.

To mount the LEDs neatly, it is best to bend the anode lead sharply at right angles to the other lead. Then, holding it against the board to get the distance right, bend it sharply back to its original direction. Push the two leads through the holes; the soldering point on the cathode lead is close to the

body of the LED so you might want to use a heat shunt while soldering.

Two of the NAND gates are not used in this circuit, but their inputs mustn't be left unconnected. You can use solder blobs beneath the board to connect these pins to the 0V line.

The board has a blank strip left along the lower edge (rows L and M) where you can attach labels to identify the LEDs. We used labels punched on special adhesive tape, but there are several other kinds of label you could use.

## Operation

Operation of the logic probe is quite straightforward if you follow these simple steps:

1. Clip the power leads to known positive and ground points in the test circuit (18V max). The power-on LED (D5) should light, and any one of the pairs of other LEDs may light as well.
2. Static Mode: Touch or clip the probe to a test point in the circuit. Either the 'HI' or 'LO' LED comes on, indicating the logic level at that point.
3. Dynamic mode, to detect a low pulse: switch 1 ON (note that with the switch we used, the knob is moved UP to turn the switch ON) and switch 2 OFF. Press reset button (S3) to light the 'R' LED. As soon as the test point goes low, 'R' goes out and 'S' comes on. Press reset again ready to detect the next low level.
4. Dynamic mode, to detect a high pulse: as in 3, but with the positions of S1 and S2 reversed. ♦

## Parts List

### Resistors

(all 0.25W, 5% tolerance)

R1 10k  
R2 680 ohms

### Semiconductors

D1-D5 Light-emitting diodes, 5mm (5off)  
IC1 4049 CMOS hex inverting buffer  
IC2 4011 CMOS quad 2-input NAND gate

### Miscellaneous

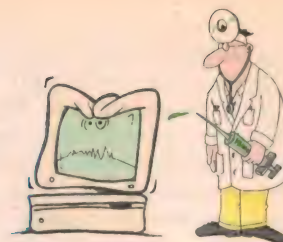
S1,S2 DIL switch, two-way  
S3 SPST momentary pushbutton switch, PCB mounting.

Stripboard 32mm x 94mm (12 strips by 38 holes); 3 x PC pins; 16-pin DIL IC socket; 14-pin DIL IC socket; 1.5mm plug or test clip for probe; pair of miniature crocodile clips (red and black); 300mm light-duty flexible wire.



# Computer Clinic

by JEAN-BAPTISTE CATTLEY



## What seems to be the problem?

Welcome to the first instalment of this new monthly column, where I'll try to answer your computer related questions. While this month's edition is fairly Win95 oriented, I intend to cover all kinds of systems in coming months. Whether you're having problems with your operating system, a particular application, or just need advice, this is the place to ask for help.

I'm also including a section called 'DOS Box', where I'll include lots of useful DOS tips and tricks. In a world dominated by Win95, DOS often seems to have been forgotten, even though it is a very powerful operating system.

Of course, hardware problems can be just as frustrating as software ones, so feel free to send in your hardware troubles, or even your success stories, as these may well help other readers.

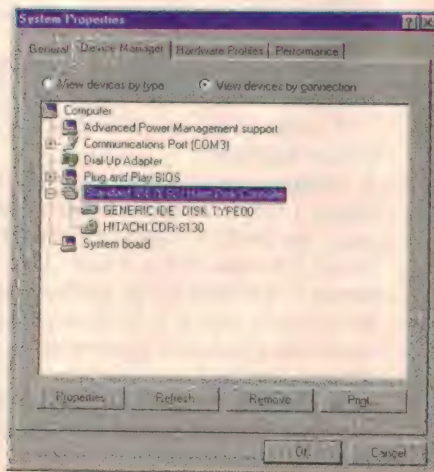
Remember, this column is going to depend on your input, so keep those questions coming...

I'll start off with a question that I think will have affected a number of Win95 users already.

### Disappearing CD-ROM

**When I restart in DOS mode from Windows 95, I can no longer access my CD-ROM drive. Why not, and what can I do to fix it? It works just fine in Win95.** (H. Pinkerton, Brisbane Qld.)

Windows 95 is rather nice in that it does a lot of things for you, without your having to think about them. Like driving CD-ROMs, for example. All you have to do is plug the drive in, and Win95 will detect it automatically, install the appropriate drivers, and seamlessly incorporate the drive into the file system.



When you exit to DOS, however, all the automatic, seamless, 32-bit plug 'n' play drivers get unloaded — and you're back to the world of 16-bit software, CONFIG.SYS and the 640K memory barrier. Consequently, you need to obtain a copy of the appropriate DOS driver for your CD-ROM. Look through any disks that came with it for .SYS files, especially ones with 'CD' in the filename. If you can't find anything suitable, try contacting the CD-ROM's manufacturer. If all else fails, search your hard drive for SBIDE.SYS, a very common CD-ROM driver that often gets installed with SoundBlaster software. All the CD-ROM drives I've used have worked with this driver, so it's worth a go.

For the purposes of this example, I'll assume you are using SBIDE.SYS, but if you are using another driver, just use it in place of SBIDE.SYS in the following examples. Note that the command line parameters will probably be different for a different driver, but if you haven't got any other documentation, this is a good place to start. You'll also need a copy of MSCDEX.EXE, which should already be in C:\WINDOWS\COMMAND.

Copy SBIDE.SYS to C:\DOS, right click the My Computer icon, and select Properties from the pop-up menu. Select the Device Manager tab, and click the 'View by connection' radio button.

Scroll through the list, looking for your CD-ROM. You will probably need to expand some of the branches of the tree view by clicking on the '+' signs. When you find your CD-ROM, click on the IDE Hard Disk Controller that it is connected to, and click Properties, and then the Resources tab.

Now, get a pen and paper (yes, even in this digital age!) and write down the first number next to the first Input/Output range — there may be several, so choose the one that starts with 01, typically 0170 or 01F0. Write down the number next to Interrupt Request, and then close all windows to get back to the Desktop.

You will now need to restart in DOS mode and edit your CONFIG.SYS, which resides in the root directory.

Insert the line **DEVICE=C:\DOS\**

**SBIDE.SYS /V/D:MSCD001 /P:{I/O range},{Interrupt Request}**, where {I/O range} and {Interrupt Request} are the two numbers you wrote down. As an example, the line that I use for my computer is **DEVICE=SBIDE.SYS /V/D:MSCD001 /P:170,15**.

(If you don't have a CONFIG.SYS file, edit a new text document in C:\ and rename it afterwards to CONFIG.SYS.) This done, save and close CONFIG.SYS, and edit C:\AUTOEXEC.BAT, where you will need to insert the line **C:\WINDOWS\COMMAND\MSCDEX.EXE /D:MSCD001 /M:8 /V**.

Save and close C:\AUTOEXEC.BAT, and then restart your computer while praying to your favourite deity. When the blue Windows 95 startup screen appears, press ESC so you can see the results of these commands. With any luck, you should see lots of arcane messages from MSCDEX, telling you the number of bytes allocated for the various sections of the driver. Next time you quit to DOS, your CD-ROM drive should be there, ready and waiting...

### Moving troubles

**I moved a program to another folder, and now it doesn't work. Why?** (T. Pemberly, Collingwood Vic.)

If you're using DOS, you'll need to make sure that you move all the files from the original program directory along with the actual .EXE file. There might be directory-specific settings in any config files, so try running any SETUP or INSTALL programs again.

For Windows programs, however, it's best not to move the program itself, unless you need to do something awful to the drive it's on. If you do have to move it, you're best off using a utility like Quarterdeck's Cleansweep, which takes everything into account, including obscure registry and .INI file settings, and saves you an awful lot of fiddling around.

Things are a bit easier in Windows 95, as you can create shortcuts to a program instead. This way, you can effectively put copies of the program wherever you want to, while leaving the program in its original



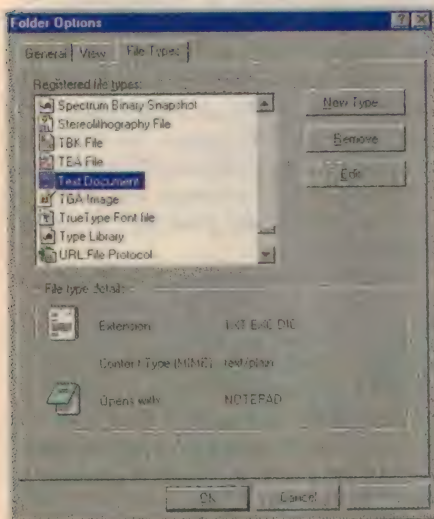
directory. All you have to do is to right-click on the program and drag it wherever you want it to end up. From the pop-up menu that appears, select 'Create shortcut here'. So far, so good. Now all that remains is to set the working directory for the shortcut.

To set the working directory, right-click on the shortcut and select Properties; click the Program tab, and type the path to the program into the 'Working' box. If you want, you can rename the shortcut to anything you want, and it will still work. You don't have to worry about file extensions, as Win95 gets the name from the information within the shortcut file itself. One thing to note is that you can put the shortcut into your Start menu by dragging the shortcut into the C:\WINDOWS\START MENU directory.

## Who runs what?

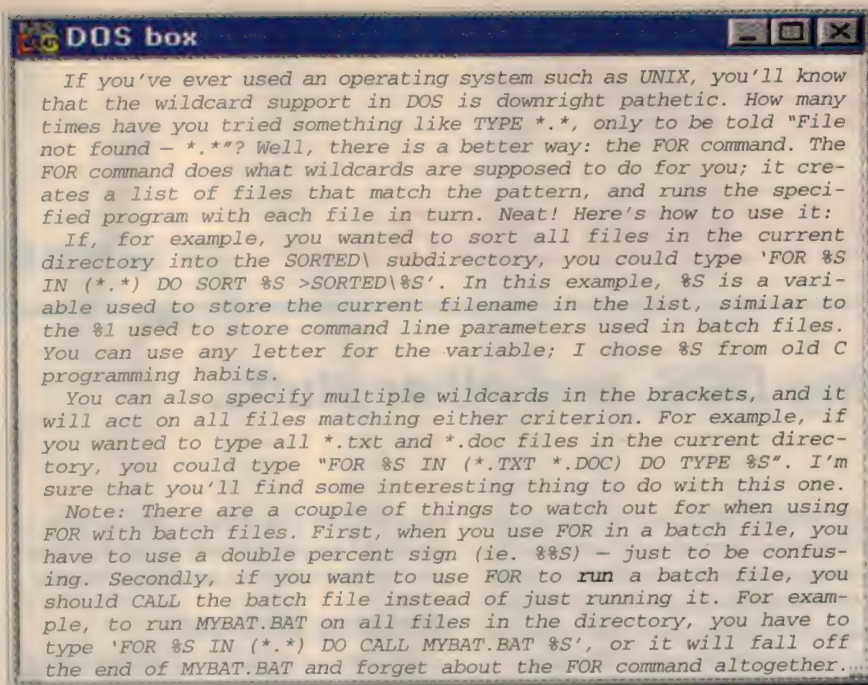
I often want to open files in one program, but when I double click the file it starts up a different application altogether. Apart from running the program I want and then opening the file manually, is there any easy way of deciding which program the file will run? (P. Burton, Hall ACT)

The default file associations in Win95 can be a bit annoying, and there are many ways



of getting round them. You have two main options: either change the default association to the program you prefer, or work around the association mechanism altogether. First, let's look at how to change the default association for a particular filetype. In this example, I'll show you how to make all .TXT files open with Wordpad instead of Notepad. Pointless, but simple.

1. Double-click on My Computer.
2. Click the View menu and select Options.
3. Another window will appear. Click the File Types tab.
4. Scroll down the list of file types until you find 'Text Document'.
5. Select the entry and click Edit.
6. From the list of actions that appears, select Open, and click Edit.



7. Yet another window will appear, asking which program to use to open Text Documents. It should contain the full path to Notepad.

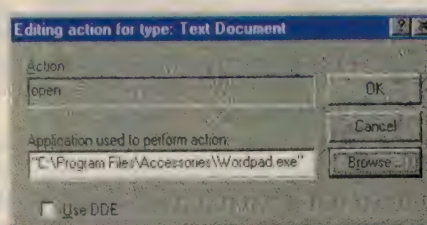
8. Replace the text in the box with "C:\Program Files\Accessories\Wordpad.exe" (including the quotes).

9. Keep hitting OK and Close buttons until all the windows disappear.

Now browse through your drive, and find a text file. When you double click it, it will open in Wordpad.

This approach will work for almost any combination of filetype and program.

If you don't want to change your default associations, you can avoid using them entirely. Here's how: Shift-right-click on the file and select 'Open with...' from the pop-up menu. This will bring up a dialog box allowing you to select from a list of already-associated programs, or browse through your hard drive for anything else.



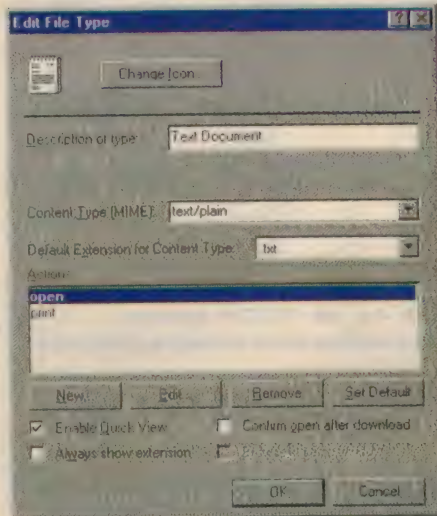
This approach is a little fiddly, and takes a fair amount of clicking around to achieve results. Luckily, there's a better way. Right-drag the program you want to use onto the desktop, and select 'Create shortcut here' from the pop-up menu. Now when you want to open a file with the program, just drag the file you want to open onto the shortcut icon.

Note that the working directory for drag and drop operations is not necessarily the directory containing the program concerned. If the shortcut points to a DOS program, you could get strange results unless you set its working directory correctly.

To set the working directory, right click on the icon and select Properties, click the Program tab, and type the path to the program into the 'Working' box. Why doesn't this get set automatically? Don't ask me.

However, it's not always convenient to have to find an icon on your desktop, so once again (and after all, that's what this column is all about), there's an even *better* way.

Drag the shortcuts into your 'C:\WINDOWS\SEND TO' directory. Now when you right click on a file, you can just Send it To your favourite program, no questions asked. In my Send To directory, I keep a shortcut to a small program that I wrote, called Anotherapp. It automatically opens up a file requester and opens the file sent to it with the selected program. You can find the program on the EA BBS, in the Useful Utilities section. ♦





# Moffat's Madhouse...

by TOM MOFFAT



## Doing DOS, and other stuff...

In last month's Madhouse we further discussed the perfect computer, and carried on the never-ending argument about Windows versus DOS. In fact, with all that good reader input and discussion, a few things bit the dust — such as details on implementing some of the ideas.

So here we go again — first with one more burst of reader input: "In general, Tom, I like your style and enjoy your column. However I get a bit sick of everybody Microsoft bashing". I don't think it's really Microsoft being bashed by me and so many readers; instead it is the bloating and inefficiency being generated by blindly following the Windows format.

Remember that Microsoft wrote DOS as well as Windows, and for that they deserve the heartiest praise. Lately they've been busy playing down the existence of DOS in favour of Windows. This leads many people to think that the DOS features provided under Windows 95 are a 'pseudo-DOS'. But it is indeed the real thing, MS-DOS version 7.

Although when you issue the VER command (to determine the version) it reports 'Windows 95', Microsoft's own MSD diagnostics program calls it MS-DOS 7.0. And I would go so far as to say Version 7 is the very

best MS-DOS ever released. But in order to use DOS 7 you must be able to 'get at it' properly, and that's what we are going to do now...

### Bringing DOS out

The idea is to get DOS 7.0 running with no influence at all from Windows. And to access your computer's hardware, DOS must have its own drivers, just as if Windows wasn't there at all. Yet it must be possible to use Windows as well, just as it came out of the factory.

The trick is to install a 'dual-boot' system, using techniques that first appeared many years ago in DOS version 5. Once you've done this, and you turn on your computer, you'll be presented with a small menu offering MS-DOS with all its capabilities, Windows 95, or a 'clean' version of DOS free of drivers that may cause problems with touchy programs.

To do the job we must hack away at three system files: CONFIG.SYS, AUTOEXEC.BAT, and MSDOS.SYS. If you're already a DOS person it's best to restart Windows in MS-DOS mode and use a DOS text editor. Otherwise you can stay in Windows and use Notepad. Either way, back up these three files in a very safe place, so they

can be restored if you make a mess of it.

MSDOS.SYS is a hidden file in the root directory; for copying and editing purposes you must make it more 'normal' by changing the file attributes: 'ATTRIB -S -R -H MSDOS.SYS'. You should now be able to see it with 'DIR'. It's also wise to make a DOS boot disk; you can use the familiar 'SYS C: A:' command on a freshly formatted disk.

Let's start with the simplest edit: MSDOS.SYS. There are two things to do here: Change 'BootGUI=1' to 'BootGUI=0'. This prevents Windows from starting automatically. Also change 'Logo=1' to 'Logo=0'. This gets rid of the pretty cloud picture and lets you watch the boot process as it takes place. Now save the file, and restore its attributes: 'ATTRIB +S +R +H MSDOS.SYS'. All done!

Now boot your computer and it should come up sitting on the good old C:> prompt. DOS LIVES!

CONFIG.SYS comes next. You may not even have a CONFIG.SYS; in most cases Windows 95 will run without it (or AUTOEXEC.BAT). In this case you must create CONFIG.SYS from scratch. Follow the example, which should be more or less self-explanatory.

Each of the menu choices has a label name, followed by text to be shown on the screen. Further down in the file are sections identified by the [label]. The [common] area is for drivers that must be present under both DOS and Windows. In almost all cases this will be left empty. The [dos] part of your CONFIG.SYS should look pretty much like the example.

If these entries are already present, move them to [dos]. If they're not present, enter them, making sure the files HIMEM.SYS and EMM386.SYS actually exist in the Windows directory. They could be under WINDOWS\COMMAND. Your [win] area will probably remain blank (see the note in the example) as will the [clean] area. You're done for now; save CONFIG.SYS and go on to AUTOEXEC.BAT.

The example mostly says it all. If you don't have an AUTOEXEC.BAT, make one, and copy the example. The PATH statement is an extension to the default path that already exists

```
[Paths]
WinDir=C:\WINDOWS
WinBootDir=C:\WINDOWS
HostWinBootDrv=C

[Options]
BootMulti=1
BootGUI=0
Logo=0
Network=1
;
;The following lines are required for compatibility with
other programs.
;Do not remove them (MSDOS.SYS needs to be >1024 bytes).
;xxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxx
xxxxxxxxxx
;xxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxx
xxxxxxxxxx
(etc...)
```

Fig.1: What your MSDOS.SYS file should look like.



in DOS 7, to WINDOWS and WINDOWS\COMMAND. Add what you feel you need. My PATH statement lets me get at my text editors, and stuff like PKUNZIP, and my utilities directory. It also lets me automatically access whatever is the default directory on drive C: while working from a different drive.

Note that AUTOEXEC.BAT has labelled areas, matching those in CONFIG.SYS. Your menu selection from CONFIG.SYS is brought into AUTOEXEC.BAT through the variable %config%, and then the GOTO statement sends you into the same area selected from the menu.

Under :dos, you'll notice an enormous SMARTDRV specification. It produces a luxurious 8MB disk cache from the 16MB of system memory, most of which would otherwise go to waste under DOS. The other stuff is pretty standard; setting a TEMP variable, and a variable for the Soundblaster card. Make sure the WIN statement is in the :win area.

That's it for AUTOEXEC.BAT, save it for now, then reboot the computer. If everything was done properly it should present you with a menu with three selections. Selection 1 should bring up MS-DOS with a nice C:> prompt, and DOS should work just like the good old days. If you reboot again and select number 2, you should go into Windows in the normal way. Booting to number 3 should produce another C:> prompt.

You will probably discover that under DOS, you can't access your CD-ROM and the sound card won't work. So now you must install the MS-DOS drivers for them from the supplied disks. Once this is done, inspect CONFIG.SYS and AUTOEXEC.BAT and move any new

**Fig.2: Use this sample of CONFIG.SYS as a guide.**

```
REM === CONFIG.SYS for multiple boot options ===

[menu]
MENUITEM    = dos,MS-DOS
MENUITEM    = win,Windows 95
MENUITEM    = clean,Clean Boot
[common]
    rem (This is where you put stuff needed by both Windows and DOS,
    something that's not likely to happen.)

[dos]
DEVICE      = C:\WINDOWS\HIMEM.SYS /testmem:off
DEVICE      = C:\WINDOWS\EMM386.EXE NOEMS X=C800-C8FF X=C900-
CCFF I=B000-B7FF
DOS         = HIGH, UMB
BUFFERS=30
FILES=30
DEVICEHIGH=C:\WINDOWS\COMMAND\ANSI.SYS
    rem (... and here is where you put any further drivers needed for MS-DOS
    operation, such as PCMCIA cards, sound card, or CD-ROM.)

[win]
DEVICE      = C:\WINDOWS\SYSTEM\CSMAPPER.SYS
DEVICE      = C:\WINDOWS\SYSTEM\CARDDRV.EXE /slot=1
    rem (Windows doesn't usually need any drivers in CONFIG.SYS, but these are
    necessary to make Win95 recognize my static RAM PCMCIA memory card. If you
    have similar requirements, here's where to put them.)

[clean]
    rem (I need a clean boot option on my computer because my MS-DOS Iomega
    Ditto tape backup software won't work while the PCMCIA drivers are in
    place. Clean Boot also provides a known environment in which to
    experiment with new DOS software.)
```

entries into the respective DOS areas. Reboot and these features should come to life.

You may be disappointed to discover that your modem doesn't work under DOS. This is

most likely because it is an RPI variety that requires drivers under Windows to function at all. If this is the case, consider replacing the modem with a non-RPI model. It will then work under DOS, and probably work a lot better under Windows.

## DOS Web browser

No such thing as a DOS-based Web browser, huh? Well, the Tasmanian tourist blurb in the picture arrived by solely MS-DOS means — no Windows at all. Dedicated programmers in Czechoslovakia have been plugging away, and the result is Arachne, a DOS web browser. You'll notice that the screen shot looks pretty much like any Windows-based product, displaying up to 16 million colours on a VGA screen.

The user interface, however, is a little weird; it looks like it was chiseled out of stone, right out of the 'BC' comic strip. When something is downloading, the 'X' in the upper-right flashes blue sparks to indicate activity. But looks aside, Arachne goes like a rocket; it loads in an instant and brings content onto the screen at the fastest speed your modem will allow.

The point about Arachne is that it proves it is possible to browse the World Wide Web under MS-DOS, with results just as good, and often much faster, than under Windows. If you want to play around with Arachne yourself, you can download it from <http://www.naf.cz/arachne/>.

```
REM === AUTOEXEC.BAT for multiple boot options ===

PATH C:.;C:\;C:\UTILS;E:\EDITORS;E:\ARCHIVER
    rem (These are additions to the path statement already built into DOS 7.
    They are needed for accessing files while working in pure DOS, as well
    as working in an MS-DOS window from Win95. So they apply in all cases.)

GOTO %config%
    rem (this command branches to the choice made in the CONFIG.SYS menu.)

GOTO end
    rem (This is insurance in case the menu choice is incorrect.)

:dos
C:\WINDOWS\SMARTDRV.EXE /X 8192
SET TEMP=D:\TEMP
SET BLASTER=A220 I5 D1 H3 T4
    rem (... and here you can add any further commands needed for your
    MS-DOS applications, CD-ROM, etc.)

GOTO end

:win
WIN
    rem (Here we start Windows with nothing added except the PATH statement.)
GOTO end

:clean
    rem (Here we start DOS with nothing added except the PATH statement.)

:end
```

**Fig.3: And here's what your AUTOEXEC.BAT should look like.**



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- Data Hold, Mem, Rel.



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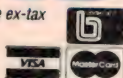
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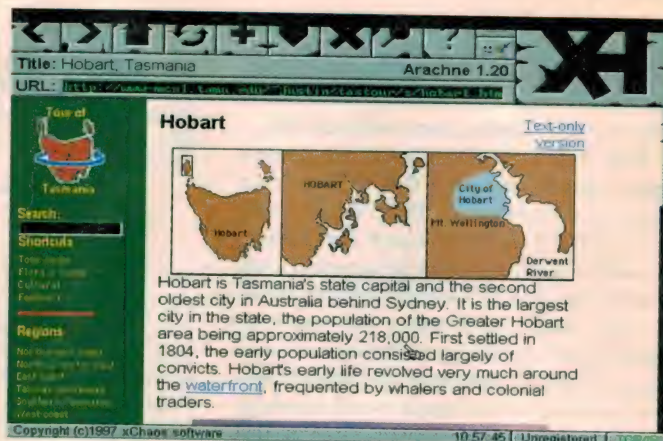
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## Moffat's Madhouse...



A page downloaded from Tasmania, using the DOS-Based Arachne browser.

## Info on Opera

In the e-mails I received about the Perfect Computer article, several people asked about the Opera WWW browser I'd mentioned. So here's the skinny...

Opera is produced by a company in Norway (<http://opera.nta.no>) with only nine employees. It comes in both Windows 3.1 and Windows 95 versions. Its look and feel is much like Netscape and Internet Explorer, although it fits into a downloadable file just over 1MB long, about a tenth the size of the 'big fellas'. This is because Opera is written almost totally in assembler (machine language) code, instead of one of the big Windows application languages. So Opera is fast to load and fast to run.

Opera is evolving day by day, and there never seems to be a 'final' version. As this is being written, Opera is in Version 3 Beta 8. Users all over the world are acting as beta testers, resulting in some lusty discussion on Opera's BBS page and some of the newsgroups. And, of course, there's lots of Microsoft and Netscape bashing, as Opera users say "nyah-nyah!"

There are still some bugs in Opera — the newsreader feature usually forgets to get the latest messages, and the browser sometimes mangles graphics stored in its cache. There is support for Java Script, a little buggy just now with frequent crashes. And so far no support for Java itself.

In my own computer I have three browsers — Opera, Netscape, and Internet Explorer — but I almost always fire up Opera for web browsing because it's just such a slick program. Occasionally I must bring up Netscape when there's some Java site that I 'must see', but usually I just ignore them. I'm still a little touchy about letting someone else's executable code run in my computer without my permission...

## An MS-DOS Opera?

At this stage, probably not. I have been communicating with Helmar Rudolph, Opera's head customer-liaison guy (they'll all talk to you there, even the chief programmer...) and he is a little worried about the future longevity of DOS. Also he raises the point that many DOS users are using ancient computers, refusing to buy anything newer, and maybe they would be reluctant to cough up for Opera too. (It's shareware, with a 90-day trial period before it expires).

But Helmar never did give a definite 'no'. He's keeping his options open, as are the rest of the Opera people. They are certainly rattling the cages of the 'big two', whose latest browser software is very difficult to run in smaller computers with Windows 3.1. And, as bigger versions come out, the earlier, smaller versions are yanked from distribution. So the small-computer market is becoming more and more the domain of companies like Opera, and Arachne. It will be interesting to see where this ends... ♦



## ELECTRONICS AUSTRALIA'S READER INFORMATION SERVICE COMPUTER BULLETIN BOARD

As part of its service to readers, *Electronics Australia* operates a Reader Information Service Bulletin Board System (BBS). This makes available a wide range of useful information, for convenient access and rapid downloading by readers equipped with a personal computer and modem. We know that a high proportion of our readers have these facilities, nowadays.

Here's an idea of what's currently available on the BBS:

- Software needed for recent PC-based EA construction projects
- Index files for EA and ETI construction projects
- Recent notes and errata, both published and as-yet unpublished
- Useful public domain and 'shareware' software for electronics and amateur radio applications.
- General interest shareware utilities, such as the commonly-used compression and decompression utilities used for efficient storage and faster file transfer.
- The ability to upload Letters to the Editor, and/or contributions to our Forum and Information Centre columns (send them as plain-text ASCII files, please)
- An on-line 'Discussion Forum' facility, which allows readers to exchange useful technical information directly.

The *Electronics Australia* Reader Information Service BBS is ANSI-compatible and is currently operational for virtually 24 hours each day, seven days a week, on (02) 9353 0627. Your modem can be set to any standard speed from 300 to 28,800b/s full duplex, with a data format of '8-N-1' (eight data bits, no parity and one stop bit). So feel free to call up the *Electronics Australia* BBS, and take advantage of its facilities. Your only outlay will be the usual cost for a phone call...

## FORUM

*Continued from page 28*

long), but we've certainly seen the same kind of downturn in the servicing industry due to the reducing cost of new equipment from the countries to our north. When you can buy a new CD player for less than \$200, or a new colour TV with remote control for as little as \$280, it's very hard to persuade customers to repair their existing gear...

You're probably right in guessing that this kind of problem might not be so bad in remote outback towns, although these areas have been pretty depressed for other reasons. Still, if we get any letters from people interested in securing your services, I'll certainly pass them on!

And that's about it for this month, folks. I hope you'll join me here again at the Forum next time. ♦

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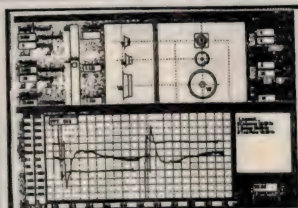


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# INFORMATION CENTRE

by PETER PHILLIPS

## Front panel artwork, batteries & TV convergence

This month I've got two design ideas you might find useful: making a good looking front panel and an automatic deep cycling circuit for NiCads. There's also our usual reader letters, including one seeking help in making a potentiometer.

I recently found a simple way to make a professional quality front panel. The only 'hi-tech' equipment you need is a computer and the software to design the artwork. You can make the artwork black and white or, if you have a colour inkjet printer, produce it in colour. For colour, print the final artwork on glossy high quality paper at the highest possible resolution.

First is the panel itself. I used a piece of fibreglass printed circuit board, as it's perfectly flat, easy to drill, cut and file, and most glues stick readily to the fibreglass (however some glues, even epoxy, don't give good adhesion to the copper side). You also have the options of an earth plane (from the copper), or an insulated panel. The only limitation is its lower physical strength compared to aluminium or steel. Supporting the panel properly solves this.

Design the artwork to at least the stage where you have the position and cutout size for each control, and print it out as a template for cutting the panel. I found it best to glue the template to the fibreglass, then drill and file each cutout. Sand off the template to leave a smooth surface for the artwork.

Complete the artwork, then have it laminated. Make sure you include a centre mark in each cutout, so you can pierce holes in them to help locate the artwork on the panel. Then glue the laminated artwork to the panel with epoxy glue. Don't use contact glue, as it leaves bumps in the artwork. When the glue is dry, use a sharp knife to cut out the holes for the controls.

You'll find the edges around each cutout will be somewhat rough, no matter how much effort you put into smoothing them. This is not a problem if the control knobs cover the edges, but in my case I had push-buttons in the design, which meant the edges around the buttons were clearly visible.

To solve this, I lightly sanded the surface of the laminated artwork with 1000 grit wet and dry abrasive paper. This not only smoothed all the edges, but it removed the gloss and gave a matt finish,

which I preferred. If all edges are hidden, you have the option of leaving the gloss finish. The total cost was around \$4 for the laminating, and the end result is an excellent looking front panel.

And, before we turn to our first letter, I have now confirmed the story I presented last month about why Russia lost the space race. The scientist's surname was Kolohev, and he did indeed request that the Minister for Health perform the operation. Of course we'll never know what might have happened if Kolohev had not died on the operating table...

### Batteries

The next two letters deal with batteries of one type or another. The first is about nickel metal hydride (NiMH) batteries:

*I recently replaced the NiCads in my cordless phone with NiMH types, and unlike the NiCads, the performance is excellent. That is, there's no memory effect and the batteries last longer. I had previously fitted NiMH cells to a torch, and have only had to charge it once in six months. But is there a catch, as it all seems too good to be true?*

*Jaycar claims these batteries have a higher current capacity (than NiCads), no memory effect, a flat discharge curve and so on. Do you have any information on these batteries, as I can't find much about them?* (Rex Shaw, Barmera, SA)

You're quite right Rex, there's not much information on these cells, probably because they're still relatively new. The best I can suggest is an article I wrote about new advances in NiMH technology, in the October 1996 issue. I researched the article from manufacturers' information and other sources.

It appears however that Jaycar and I disagree about some aspects of these cells. For example, according to my research, NiMH cells *do* in fact suffer from a memory effect, although I don't know to what extent. As well, the output voltage on discharge is pret-

ty similar to that of a NiCad. But there's no doubt these cells are better than NiCads.

The next letter concerns deep cycle lead-acid batteries and, to an extent, NiCads.

*Regarding R. Gebhardt's enquiry in November 1997, I can confirm that it's perfectly OK to charge deep cycle lead-acid batteries from a 14V automotive charging system. I've had experience with Exide Failure-X ultra deep cycle 2V cells connected in series to power a 12V domestic power system.*

*I found that in the absence of sunlight, the easiest way to charge the battery was to connect it to the car charging system and run the engine until the battery was charged. The car is a Toyota HiAce, with a 14V regulator on the alternator.*

*Also, in response to Darren Yates' enquiry about 'blasting' NiCad cells (Experimenting with Electronics, November 1997), I have had success doing just this. I hit a totally dead 12V NiCad pack with about 60V at one amp for well under a second and it did quite a bit of good. After subsequent deep cycling, it's now as good as new.* (Vasanth Crabb, Bellingen, NSW)

Thank you for this information, Vasantha. I can't comment about deep cycle lead-acid batteries as I've had no experience with them, but obviously you have, and have found no problems charging them from a 14V car charging system.

'Blasting' NiCads with a high voltage is a method of destroying dendrites that grow inside the cell. These can eventually grow large enough to short the cell, preventing it from charging. If there's nothing else wrong with the cell, removing the dendrites can often make it functional again, as you've found. Deep cycling (full discharge, followed by a charge cycle etc) is a method of eliminating the memory effect.

Incidentally, as I write this, I'm in the middle of developing a universal NiCad charger that features a variable constant current source, an inbuilt digital amme-







component of the field — perhaps it's to do with the alignment of the electron guns? Incidentally, turning the kitchen TV upside down fixes the picture but it does nothing for the Kiwi run rate. (John Hill, Wellington, NZ)

Very interesting, John. We can theorise all we like, but from your experience, it seems there's something going on. I'm interested to note what you found on the Internet, and that some manufacturers go to the trouble of making different models for each hemisphere.

Regarding TV monitors, I suggest a 60° dip angle in the Earth's magnetic field is significant, and that if you hold the monitor at this angle, then turn it upside down, there won't be as much effect on its convergence. That is, keep the set parallel with the flux lines while rotating it. Try it, I'd be interested in what you find. And perhaps it might help the cricket scores!

The next letter on this subject makes similar observations.

I recently lived in Hong Kong and purchased a large stereo TV to replace our original and ageing set. It's an amazing set, with lots of features. After returning to Australia, we installed it in our new lounge room, tuned into the local stations, and found ourselves looking at a ghastly mess of mixed colours. My brother, who is involved in electronics, suggested the trip from Hong Kong was responsible and degaussed it with a degaussing wand. This restored the set to as good as new.

Sometime later the set was moved to a town in rural Victoria without problems, but on its return to Melbourne, we noticed the picture had changed colour in one corner. Nothing like the Hong Kong experience, but enough to suggest it needs degaussing again. (Nigel West, Surrey Hills, Vic)

I'm not sure, Nigel, if the Earth's magnetic field is responsible for the convergence problems you found when you moved the set from Hong Kong to Australia. This could have been caused by any external magnetic field, such as from a speaker magnet, or even a shipping container. In my servicing days, I often needed to degauss sets that had been affected by something as simple as turning on a vacuum cleaner that was too close to the set.

But, assuming similar conditions when moving it, clearly the trip from Hong Kong had more effect on the set than a trip within

Australia. So from the above two letters, I guess there must be something in the newspaper article that started this discussion.

## Distribution amp

Staying with TV, here's a letter that asks about the 100MHz distribution amplifier in the December 1997 edition.

I am a retired TV serviceman with an interest in ham radio. I have two TV sets and two VCRs connected to the TV antenna via a commercial four-way splitter. Our reception is just adequate, and could be improved by a booster amplifier. However, this will cause my radio transmissions to interfere with the TV signal, making my wife unhappy.

I am wondering if the video distribution amplifier you published could be used as a no-loss or low gain splitter. Could you please advise. Incidentally, many years ago EA published a design of mine: a shorted turns tester. (R. Schilling, Kallangur, Qld)

In my servicing years, I built your tester Mr Schilling, and used it many times. A great little device that helped me considerably. So, can I now return the favour?

The bandwidth of the amplifier is flat to 100MHz, extending to 300MHz at -3dB. It therefore covers the VHF band, but falls well short of the UHF band. It also has a unity gain (up to 100MHz, less thereafter).

As the article explains, the unit can be configured to have one input and four outputs, so it's possible to use it as a unity gain four-way splitter, but only for VHF.

I assume your current splitter is a passive device, with the usual losses. Using the distribution amplifier in its place will therefore overcome these losses, giving an apparent gain over your existing setup. But my guess is that it will also give a corresponding increase in the interference caused by your radio transmissions.

You might be able to overcome this problem by fitting a suitable RF filter in the antenna circuit, perhaps at the input of the splitter. I can't give you any details of such a filter, but they used to be available commercially, so I assume they still are.

You might contact a local TV antenna company, or even a servicing organisation, as this kind of problem occurs a lot. There could be a commercially available distribution amplifier with inbuilt radio filters you can connect between the antenna lead and your existing splitter.

## What??

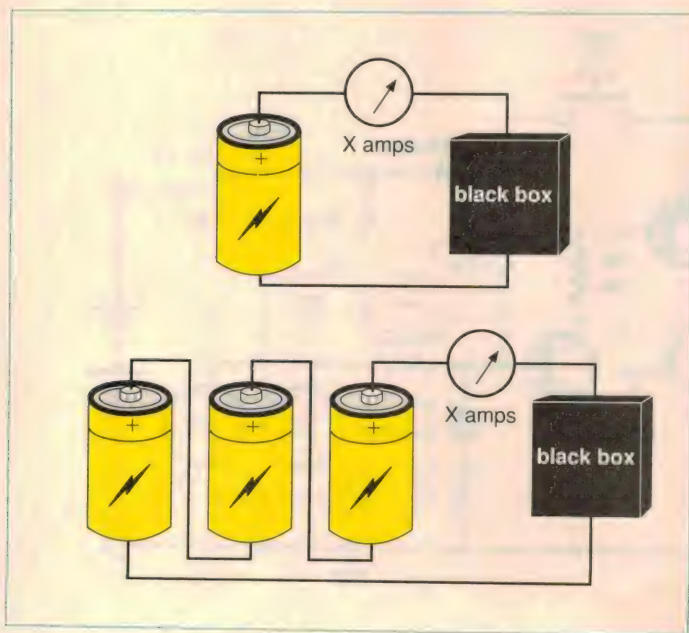
We haven't had a 'black box' question for sometime, so see how you go with this one, which was sent to me by Charles Slater of Fairy Meadow, NSW. Charles asks:

A battery (or a single cell) is connected to a two-terminal 'black box' (polarity unimportant). A current of  $X$  amps flows.

Any number of additional batteries (or cells), each identical to the original are then added in series, yet the total current remains virtually the same at  $X$  amps. This assumes a negligible loss in the connecting leads. What is the simplest device you can fit inside the black box to produce this effect?

## Answer to February's What

Assuming the rock sinks to the bottom of the lake, the water level falls. When the rock is in the boat the water level is increased by an amount equal to the equivalent volume of water, spread across the lake. When the rock is on the bottom of the lake, the level is increased only by the volume of the rock, which is less. Or when the rock is in the boat, it's supported by the water, and when it's on the bottom, it's supported by the bottom of the lake. Shades of Archimedes! ♦



**Fig.2: What's in the black box, to cause the current taken from one or many identical series-connected cells to remain the same?**



# Experimenting with Electronics

by DARREN YATES, B.Sc.



## Seven-segment displays

This month, we look at circuits involving seven-segment displays, plus some unusual circuits for your circuit notebook.

Arguably, the single most important feature of digital electronics is its ability to count. In fact, today's computers are here because we can not only store numbers but we can carry out quite complex mathematics.

Unfortunately, our brains don't easily take to binary notation, so using a row of LEDs to show us a digital number would be pretty nightmarish. That's where the seven-segment display comes in. A diagram of one is shown in Fig.1.

Quite simply it is an array of seven LEDs, each of which can be individually switched on so that collectively they can form any of the numeric digits.

Note that the pin-outs shown are common, but there's no standard. These match the LTS5303AR sold by Dick Smith Electronics. You'll need to check other types with their manufacturer.

The LTS5305AR has all eight LED anodes (seven segments plus a decimal point) separate, but has a common cathode connection. This normally isn't a problem, but you should be aware of how it's driven. Some displays are common-anode.

In days gone by, these displays were preceded by old gas-filled 'nixie' or vacuum fluorescent tubes where each digit, 0 to 9 was pressed out of metal and when appropriately connected, would glow.

Today's seven-segment displays work just as well and consume far less power. They can be used in pretty much any counting circuit but back in the 70s, their most popular use was in digital clock projects. These days digital clocks cost less than \$10 from your local variety store so there's little call for clock circuits. In fact, a few years back when I went looking for a clock circuit using discrete components, I couldn't find one that didn't use a fancy chip. In the end I had to roll my own. The circuit is too big for our purposes here, but if there's enough interest, we could come up with something.

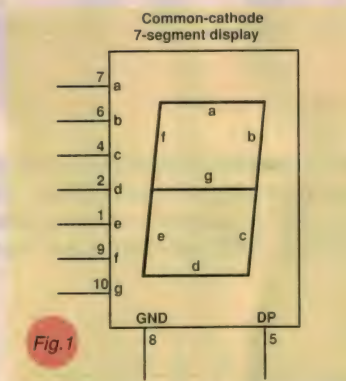
### One-digit counter

Thankfully, the engineers who designed the CMOS ICs realised that what they were doing previously using discrete transistors and logic, could all be squeezed into a single IC.

In fact, there are a number of ICs dedicated to driving seven-segment displays and one of the more uncommon is the 4026 decade counter-display IC. A simple circuit using this chip is shown in Fig.2. As you can see it uses little else but the 4026 IC and the seven-segment display.

If you feed a low frequency square-wave into the clock input, of say no more than 2Hz, you'll see the counter count up to 9 and back to zero. The chip can cope with up to 6MHz.

While I haven't shown the square-wave oscillator, we've looked at plenty in the past so you shouldn't have too much trouble. (Just remember to use the same supply rails and make sure you join the ground connections of both circuits together.)



The IC has a built-in decade counter, latch (or memory) and display driver all rolled into one. To keep things simple, we've tied all unused inputs to ground.

As with all other 4000-series CMOS ICs, you can use a supply voltage anywhere between 3V and 15V; however you need to ensure that the display current for each segment doesn't exceed 5mA. Now I know the specs will say it can deliver a little more, but these things aren't all that cheap and it's safer to be a bit conservative.

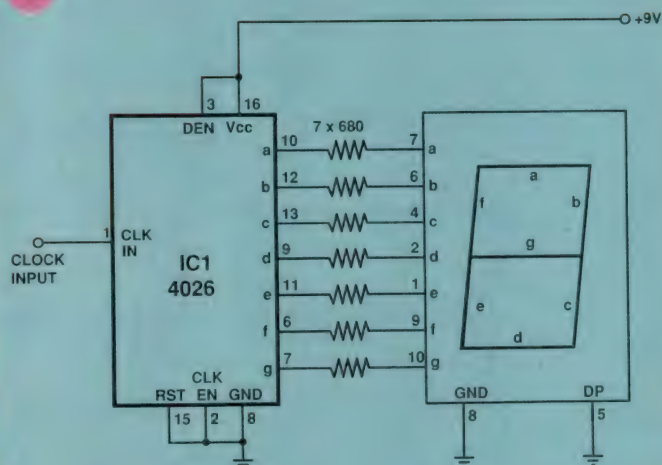
For a display driver, the 4026 is quite weak compared to the 4511 which can deliver more than twice that amount of current.

### Three-digit counter

Of course, a single-digit counter isn't going to get you too far. One of the most useful features of the 4026 is its carry-out pin. This pin completes one clock cycle for every 10 input clock cycles, and it just so happens that the rising edge of the pulse occurs when the count swings round from '9' to '0'.

All you have to do is connect the carry-out pin from the lower-decade counter to the clock input of the higher-decade counter to gang these chips together. There's no real limit on how many times you can do this, but it's probably not practical to do more than six as the current to drive the seven-segment displays from a single supply source becomes excessive.

Fig.2





A circuit for a handy three-digit counter is shown in Fig.3.

As we mentioned, the only thing really is to connect up the carry-out pins to the clock input pins successively. Note that if you need to reset the counter, all the reset pins must be tied together as you can see from the circuit...

One pin I haven't used at all on the 4026 is the 'ungated C-segment output'. While the other segment-output pins are controlled by the display enable pin, this C-segment output at pin 14 is always present. It can be used to create certain 'divide-by' factors such as divide-by-12 and divide-by-60, ideal for designing your own clock circuits.

## Don't have a 4026?

One of the down-sides of the 4026 is that unfortunately it's not all that easy to get; and having all the bits inside it, it's not as cheap as other CMOS ICs. So showing circuits using just a 4026 would be pretty close to useless without giving an alternative using common 'garden-variety' chips. The circuit in Fig.4 is an alternative — just not as neat.

This circuit is built around two other ICs we haven't used before: the 4518 dual BCD up-counter and the 4511 seven-segment display driver. 'BCD' stands for Binary-Coded Decimal, and the way the 4518 works is that it produces a four-bit binary output from 0 to 9. There are two counters in the chip, allowing us to count from 00 to 99.

The unfortunate thing about the 4518 is that by the time you build in two counters,

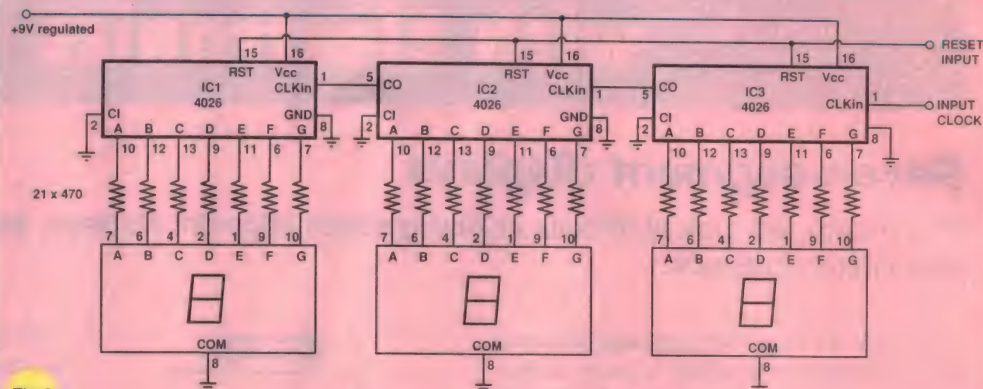
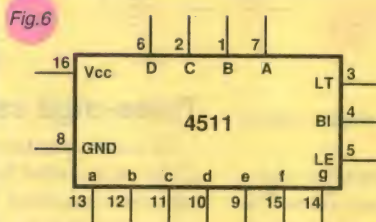


Fig.3

there are no pins left in the IC package to use as carry-in or carry-out connections. The only way you can gang the counters together is to add in an AND gate. Rather than waste



*Fig.6*

most of a 4081 AND gate IC, we've discussed before how to make an AND gate out of diodes — and this is a perfect place to use

this scheme.

Despite the lack of carry pins, the designers made it relatively easy to gang these counters together. The 4518 has two clock inputs for each counter. With CP1 high, the count advances on the rising edge of an incoming clock pulse on CP0 i.e., LOW to HIGH but with CP0 low, it advances on the trailing edge of an incoming clock pulse on CP1 i.e., HIGH to LOW.

While the units counter built around IC1a receives the input clock pulses on CP0, the decades counter of IC1b gets its clock pulse via our makeshift AND gate on CP1. Since we want the decade counter to advance when the units counter goes from 9 to zero, we simply have to detect when the count is at nine and then goes back to zero. That's what the AND gate does.

The output of the gate only goes high when the output is 9 and then falls as it returns to zero.

The 4511 display driver IC is one of the most commonly used ICs — if you look back through the pages of *Electronics Australia*, you'll see it's been used in plenty of projects over the last 20 years or so.

This is a pretty simple chip that has some very useful features. In its basic mode, you simply feed in a four-bit BCD number in at one end, and it spits out the corresponding seven-segment display code at its output pins. Pretty simple, huh!

This circuit uses two of them, one for each digit.

## Change direction?

The major limitation on the 4026 and 4518 counters is that they can only count *up*. If you want to get fancy and be able to count *down* as well, that requires another completely different circuit.

The circuit for a single-digit up-and-down counter is shown in Fig.5. Note that it requires more chips to add in this extra func-

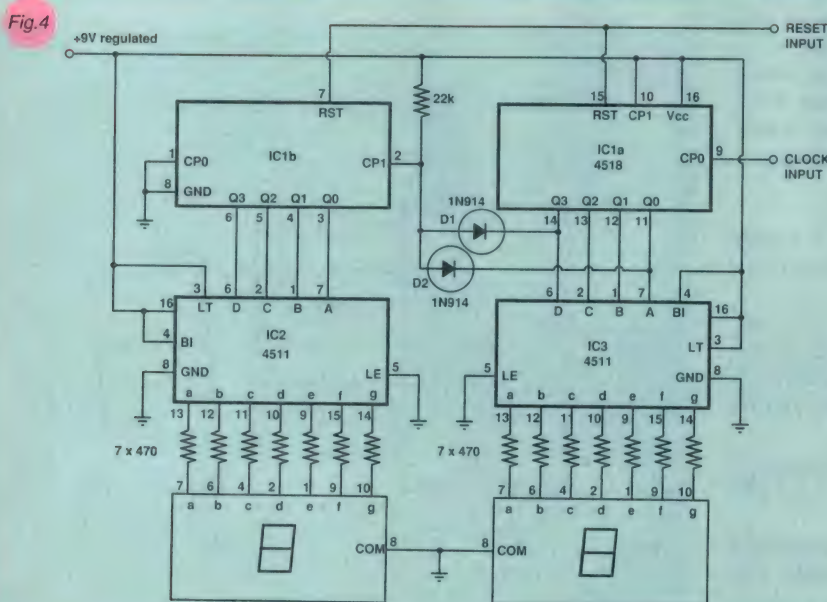


Fig.4



tionality. While we still use the 4511 driver ICs (I told you they'd be useful...), the main brains of the circuit comes from the 4029 IC. This is an up/down presettable binary/BCD counter. Basically, you can think of it as a do-everything chip. The only problem is that you only get one decade per chip.

The presettable pins J0-J3 allow you to load in a predetermined number into the counter, from which it will count either up or down depending on the logic level at the UP/DOWN input on pin 10. It's a great idea, but I haven't come up with any real ideas on how to use it. Except one obvious one...

As you can see from the circuit, the 4029 IC doesn't have any predetermined reset input. However, the presettable inputs allow you to load a number into the counter at any time by simply taking the preset enable pin high.

If we connect all four preset inputs to ground, taking the preset enable pin high will force zero into the counter. Considering that's all a reset function has to do, it's good enough.

Another idea would be to use it in a digital volume control circuit. You'd use the presettable inputs to set the volume to mid-level, say '5' out of '10', as soon as the unit came on.

You also get carry-in and carry-out pins on this IC, making it easy to gang several together for a multiple-digit up/down counter.

As you'll figure out for yourself, if the counter has carry input and outputs, you only need a single clock pin. It's only where you don't have these carry pins that you need to have fancy clocking options.

## Memory

Up until now we've actually by-passed the 4511 display driver IC itself. This chip has two other features which make it extremely useful.

Firstly, it has a built-in latch or memory, allowing it to hold the presently displayed count — much like the lap timer display on a stopwatch. Once you release the latch, the display shows the count appearing on its four-bit input. You enable the latch by pulling pin 5 (LE — 'latch enable') high.

This makes it ideal for frequency counters, where you have a continually changing count and you need to take a 'snap-shot'. The latch makes it possible for you to maintain a visible display and update it every second or so, much in the same way as digital multimeters work.

The second feature is the blanking input at pin 4. Pulling this input low turns to the display off. Now that might not sound like the most riveting thing you've heard all day, but it forms the basis of a very good brightness control. If you feed a clock signal into the blanking input and vary the pulse width you can produce an excellent brightness control.

The trick here is that the frequency of the clock input only has to be greater than the eye can detect — which means pretty much anything above 100Hz. The eye simply averages out the pulse width and the display appears to be constantly on at a certain brightness, when it's really only switching between full and no brightness during that time. This feature is often seen in digital clock radios.

The other benefit of this is that it is electrically more efficient. Most linear brightness controls rely on a dropping resistor to reduce the voltage across the display LEDs. The resistor simply wastes energy by dissipating it as heat.

The digital control is switching between on and off, so there's no power wastage since there's no dropping resistor.

Any of the PWM oscillator circuits we've covered in past pages of Experimenting with Electronics would be ideal for this task.

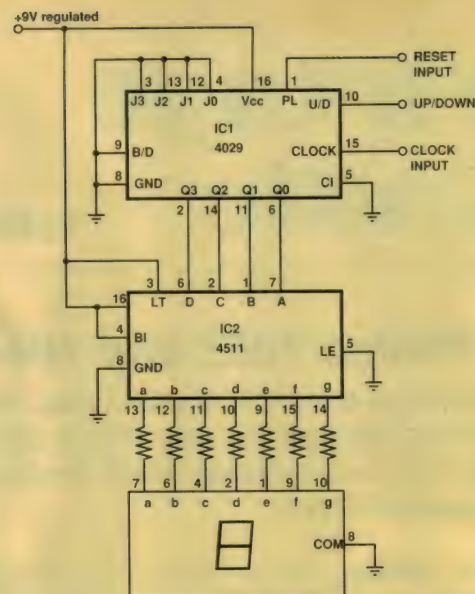


Fig.5

## Driving displays

You'll have noticed that we're driving these seven-segment displays directly from the output of the display drivers. These chips are among the few with enough 'grunt' to provide the current required to get sufficient brightness out of one of these things. But don't get carried away — the most I'd recommend you draw from each of the output is about 5mA.

Note that the 4026's outputs are particularly weak — which is a pity, because the IC has plenty else going for it. You can only get about 7mA at best, and that's at the maximum 15V supply. Less supply voltage gives you less drive current, so think about your options before you commit to your design and PC board layout.

Many of the electronics stores are now selling large-size seven-segment displays and if you're tempted to use them, don't drive them directly from the CMOS IC. These displays typically have two or three LEDs in series for each segment of the display, and from previous experience they require more current and voltage to get a bright display from them.

I recommend you look at separate transistor drivers for larger displays. As most of these larger displays are common-cathode, it makes it a little more complicated. You could simply connect the drive output to the base of an NPN transistor with the emitter connected to the corresponding

display pin via a current-limiting resistor; however you lose 0.7V through the base-emitter drop. If you're not using too many volts this could be excessive.

Depending on the number of LEDs used in each segment, you'll need to allow enough supply volts to be able to drive them.

Most suppliers will have spec sheets for these devices — check them carefully before you design your circuit. If you push the components in your design too hard, you may find that you'll have to spend time repairing it from time to time.

OK. That's enough for this month. There's plenty there for you to experiment with. Provided you exercise commonsense, there's plenty of room for your own imagination with these circuits.

Next time, we'll continue with some more circuits for you to experiment with. See you then. ♦.

## Data on the web...

Looking for more information on the ICs used in this column? If you're on the web, you can download datasheets on these chips from the following web sites:

4026: <http://www.st.com/stonline/books/ascii/docs/2038.htm>

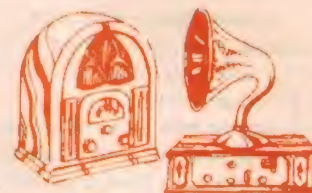
4511: <http://www.fairchildsemi.com/pfj/CD/CD4511BC.html#Datasheet>

4518: <http://www.semiconductors.philips.com/cgibin/newsearch/pip?type=nr=HEF4518B&search=HEF4518#datasheet>

4029: <http://www.fairchildsemi.com/pfj/CD/CD4029BC.html#Datasheet>

These files are all in PDF format, so you'll need to use Adobe's Acrobat Reader 3.0 or 2.1. If you don't have a copy of this, you can download it free (except for your Internet Service Provider and phone charges) from Adobe Systems' web site at [www.adobe.com](http://www.adobe.com)





## The Philips 1052 and 1044: clumsy construction

Constructing a domestic mantel radio using three sub-chasses sounds pretty weird, and it was — especially doing it the way Philips chose, with their models 1052 and 1044 of 1938-39. This plus the dial cord stringing made the sets something of a 'nightmare' for servicing or restoration, as we shall see.

Generally speaking, Philips radios were soundly designed, reliable and good performers. However the same could not be said of certain examples of their production engineering. (Kindly note, Philips fans, that it is not the intention of this story to condemn your favourite brand by reference to merely one or two poor examples. To do so would be boorish...)

Unfortunately the fact remains that the Philips 1052 and its battery equivalent the 1044 were assembled on three sub-chasses, in a manner that was not only difficult from a servicing point of view, but in many ways bordering on the absurd. I have only been able to discover two possible reasons for this quirky physical format — both of them speculative.

Mr Ray Kelly, writing in *HRSA Newsletter* No.27 (January 1989) suggests that Philips were not satisfied with the 'no chassis' construction of the V7A 'Theatrette' for 1937, so they opted for a modification; hence the three sub-chasses screwed to a wooden baseboard. Briton, on the other hand, persisted with the 'Theatrette' style of construction.

(In fact, with reference to the 'Theatrettes', one could be forgiven for assuming that the Briton models were made by Philips under some form of agreement, and were finished with the 'Briton' accoutrements. If any reader is certain of this, perhaps they would kindly set the records straight.)

The other reason why Philips may have opted for this approach with the 1052 and 1044 is that they initially had in mind the large table model 2262. Supposedly, it was discovered that a mistake had been made in the moulding plant in which the cabinet for the 2262 was made the wrong size — it was too small. Rather than throw out the small cabinet and re-tool for the 2262, it was decided to employ the



**Fig.1: A comparison between the cabinets of the 1044/1052 mantel set (right) and the more pretentious 2262 (left). One theory has it that the weird three-chassis construction of the former was because the initial case moulding was too small...**

smaller cabinet and modify the 2262 design, which resulted in the 1052. Once again, if any reader is certain of this perhaps they would also put the records straight.

A comparison of the two cabinets is shown in Fig.1. The 2262 is another very good performer, and warrants a feature article of its own.

### The circuit

The 1052 was the mains-powered version, and came in two versions. Both circuits appear on page 239 of the *Australian Official Radio Service Manual Volume 3* (i.e. 1939). The original versions have a serial number less than 8000, whilst the modified version has a serial number greater than 1/8001. The differences are subtle, yet apparent. Note too that each version has its own parts list.

Both versions consist of a basic 4/5 valve superhet. The valve line-up in each case is the P-based EK2 converter, the pre-octal series 6D6 IF amplifier, a type 75 detector/AGC/audio and the P-

based EL3 in the output. The types EK2 and EL3 and their octal equivalents were extensively used by Philips. The rectifier is the reliable four-pin 80 in the earlier version and its octal equivalent the 5Y3-G in the later version.

By reference to the circuits we see that the earlier version (Fig.2) has a separate coupling coil, L6, to facilitate the bandpass coupling, whilst in the later version bandpass coupling is provided by a tap on L5. Also, in the later version, AGC is switched out of the converter valve on short waves by switch bank 5, where as in the earlier version this is achieved by the 'cold' end of the short-wave secondary coil being connected directly to the back-bias system.

In the modified version, the EK2 screen resistor, R4, is taken straight to HT instead of via the oscillator anode resistor denoted as R7 in the original. In the later version, the broadcast band coil of the EK2 oscillator anode coil is shorted on short waves by virtue of S4. Otherwise the circuits appears to be the same.



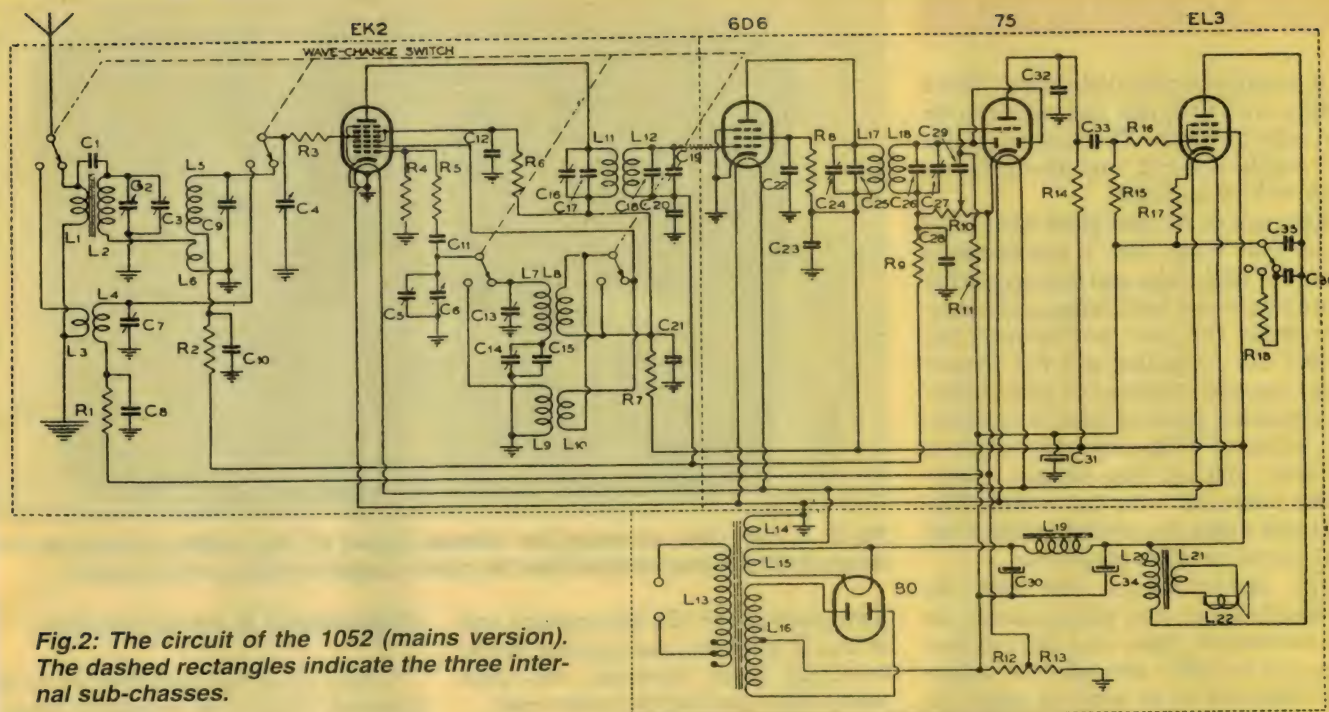


Fig.2: The circuit of the 1052 (mains version). The dashed rectangles indicate the three internal sub-chasses.

## Battery version

The battery version is designated as model 1044, and it is this version which is shown in the photographs. The construction of the two is almost identical. In the mains version the power transformer, rectifier and filter capacitors are all mounted on the middle chassis.

The battery version does not have bandpass tuning. Perhaps the designers assumed that these sets would be sold mainly in the rural locales, where selectivity was not such a pressing issue, and consequently they were

able to effect a cost saving.

The circuit is otherwise fairly straightforward with the exceptions that AGC is switched out of both the converter and the IF amplifier on short waves, and grid leak bias is applied to the converter on short waves. The valves types are the P-Based KK2, KF3 and KL4, and the octal based 1K7-G detector/AGC/audio. It seems that there was no P-Based du-diode pentode for 2V operation, only the KBC1 duo-diode triode — which probably did not offer enough gain.

There is only *one* variable trimmer for all of the front end adjustments. Even though 'trimmers' are shown in the circuit, only C6 — connected across the oscillator gang (not the coil, but gang) — is actually a variable trimmer. All of the other types, including the IF transformers, have the pre-set wirewound types. Alignment, therefore, becomes a bit of a problem!

## Getting it apart...

The first hurdle confronting the novice restorer is getting one of these sets apart. Admittedly, there is a detachable floor to the cabinet, but that is fairly pointless because removing the floor does not reveal any of the under-chassis components at all. In fact, each of the three sub-chasses is bolted in

Fig.4: Photographing a black hole is not easy, but the pulleys on the inside of the cabinet can be seen here. It makes disassembly very interesting — not to mention reassembly!

some way to the cabinet floor.

Is simply unscrewing the obvious screws sufficient to remove the chasses? Good heavens no! The first job is to unthread the dial...

The really dumb aspect about the dial is that the pulleys are mounted on the *inside* of the cabinet. Think about that! The only way this can be achieved is to remove the dial glass, and then you can place your hand through the dial aperture, and by feeling your way along, unthread the dial cord. One needs to feel one's way, because one cannot actually see a darned thing.

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If unthreading the dial seems to be a chore, wait until the dial needs to be *threaded up again!* That is not a job for the feeble-of-mind, and tranquillisers may well be required.

Removal of the dial glass itself is no mean feat. When new, it was mounted in rubber edge strips and then secured in place by pressed metal strips and fastening screws. However over the years, the rubber has congealed and has formed what virtually amounts to a gooey adhesive sticking glass to metal to cabinet. The solution? With a hair drier or paint remover gun on low setting, gently direct warm air over the rubber. The heat will soften the rubber, and then the dial can be *carefully* prised free.

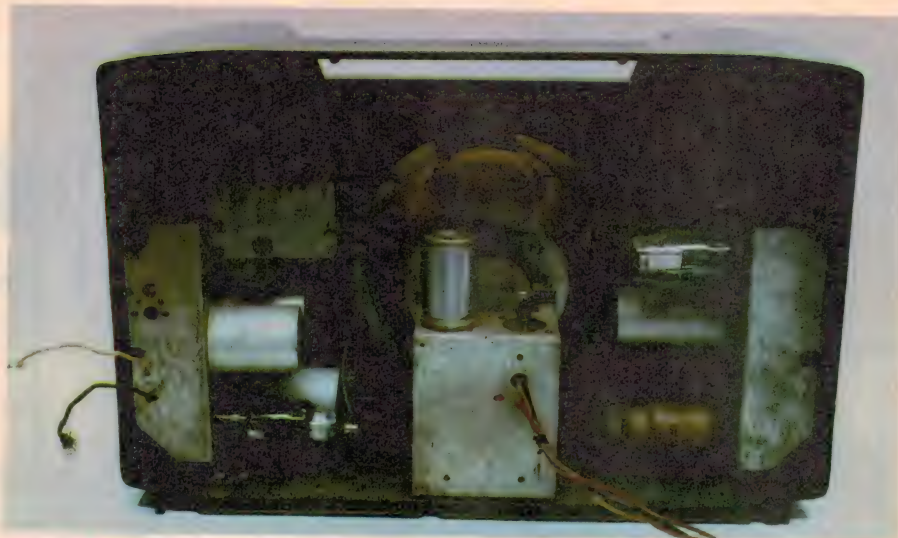
The three chasses can then be removed. But do they then sit neatly on the workbench, three in a line, so that they can be easily serviced? Of course not. They are at all sorts of angles to one another, and working on one chassis invariably means that the other two are subsequently left dangling in a most unsatisfactory manner.

## The RF and IF coils

Both the short wave and broadcast band coils are wound on a common former in each compartment, resulting in two and not four coil assemblies. This in itself is not a real problem except that the assemblies are very hard to dismount. The cans are firmly crimped around the entire diameter of the base plate, and then secured to the chassis by means of small tabs which are part of the chassis metalwork. The danger here is that if the tabs are opened too far to release the cans, they will either break off, or they will have lost their tension when the coil cans need to be replaced.

In the example shown, the set failed to operate because the oscillator section of the broadcast coil was open circuit. As there was absolutely no availability of a replacement coil, something had to be found which would at least enable the set to operate on the broadcast band. Also the KK2 had at some stage been replaced by a 1C6, with no apparent alteration to the remainder of the circuit.

One of the first jobs was to remove the six-pin socket and re-install a P-based socket and a type KK2 converter. Having done that, a temporary oscillator coil was 'tacked' in place and wired to the switch. Although the KK2 tested quite good on the transconductance tester, it failed to oscillate at all.



**Fig.3: A rear view showing the internal layout of the battery version of the receiver. The mains version has the power supply in the centre chassis.**

Subsequently, the 1C6 was returned, and at least it oscillated, and operated on the broadcast band. However, the short waves were (and still are) quite mute.

Unfortunately, a hole had to be drilled in the chassis to accommodate for the variable slug of the oscillator coil. The resulting temporary repair looks most ugly and unprofessional.

## Wait, there's more

If the convoluted assembly/disassembly system is not enough to try one's patience, the next anecdote could qualify one for sainthood. After the 'assembly' was working quite well, it all of a sudden ceased completely. The obvious checks were undertaken, and after some time and further tests, it was concluded that the signal was not reaching the KF3 grid. This was despite the actual coils being continuous.

The lead from the first IF transformer to the KF3 grid is quite long, and is shielded for obvious reasons. Now would this lead use 'normal' shielded wire such as one is accustomed to finding, say, connecting to a volume control? Nope, not when we're talking Philips. The central conductor is *solid* tinned copper wire of about 22 gauge, threaded through tiny ceramic beads, then sheathed in the shielding! Consequently, after the top cap connection to the KF3 had been removed and replaced a few times, the solid core had fractured. It was in due course replaced with something a little more conventional.

Whilst one could argue about the improved loss characteristics etc. of the ceramic beads, one certainly could not justify its use from an engineering perspective. That little fault was unnecessary, infuriating and time wasting.

## Alignment & re-assembly

Unless all of the trimmers are to be replaced, there is no alignment procedure in the normal sense. However, as one or two regional South Australian stations were received in daylight hours on 10 or so feet of aerial, it was deemed that sensitivity would be unlikely to be improved even if the IFTs had fully adjustable circuits. Electrically, the set works quite well, except that the audio quality is a little poor, probably due to the speaker having lost a degree of its magnetism.

There is absolutely no guide to restringing the dial. There are two systems; one for coupling the knob spindle shaft to the capacitor drum, and the other from the drum via the pulleys to the dial pointer. Having pondered over the matter considerably, it was realised that the spindle-drum would need to be threaded first, and then once assembled inside the cabinet, the remainder would have to be completed. Words cannot describe how to do it. It is one of those instances where an experienced person will 'see' how it goes together, while others will unfortunately be left floundering.

In the various internal photographs, the dial glass has been deliberately excluded, because it was hoped at the time of repair that a discarded chassis might appear one day with good coils that could replace the originals. Three years later lady luck smiled, which was the stimulation for this month's story.

In summary, there is little wrong with the performance of this design. The problems are mechanical, not electrical. Anyone who has successfully completed a repair on one of these sets can congratulate themselves for a job well done. ♦



## NOTES & ERRATA

**Video Enhancer & Stabiliser** (November 1997): The polarity of capacitor C26 is shown reversed in the schematic on page 55; the capacitor is connected with its positive electrode to ground. Its polarity is shown correctly in the PCB overlay diagram on page 58.

**Audio Masker** (December 1997): The pin labeling of the MOSFET (Q2) is incorrect on the overlay diagram on page 56. It is shown as gate/source/drain, instead of gate/drain/source. The schematic is correct, with the source connected to the negative terminal of the battery. Also, reader Sam Ross suggests that a 1uF Tantalum capacitor connected across the gate and source of Q2 will prevent cracks and pops when the unit is turned on. He also advises that a high volume output could damage most earphones, and that hearing damage could occur if used carelessly and without C5 or C6, due to the earphone's typical peak response at 3kHz.

**Laser-Based RS-232C Data Transceiver** (October 1997): The captions for Fig.9 and Fig.10 were transposed on page 59. In the lower diagram of Fig.8 on page 61, a link is incorrectly shown

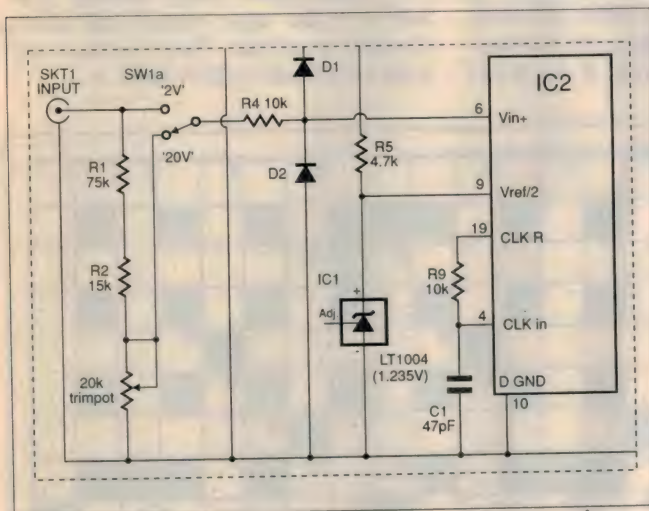
joining pins 6, 8 and 19 of the DB25 connector; it should join pins 6, 8 and 20.

**Video & Pulse Distribution Amp** (December 1997): The phone number given on page 59 for Maxim distributor Veltek is incorrect; the correct number is (03) 9574 9300.

**Voltage reference mod for Pocket Sampler** (CDI, December 1997): The schematic for the modification was incorrect, as it showed the LT1004 simply replacing the LM336. Instead the LT1004 is used to supply the Vref/2 pin directly, with the 5k trimpot (and cal/sample switch) removed entirely. The diagram below shows the corrected circuit.

**Line Carrier Link** (December 1997): The receiver unit's overlay diagram and parts list should show R15 (in series with the relay coil) as 120 ohms rather than 1.2k. Also D5 in the receiver overlay diagram is shown the wrong way around, and strictly speaking, the address programming links (LK1 to LK4) should match the code example code used in the transmitter — this can be corrected by changing the positions of LK1 and LK3.

If the mains supply used for the link is rather noisy, you may find that while the signal is being received (the 'carrier signal' LED flashes) the codes are not detected correctly, leading to an erratic response. In this case, you will need to slow the response of the clock detecting circuit (based on Q1) in both the transmitter and receiver. This can be done by changing Q1 to a BC338-type transistor (it has lower gain and bandwidth), or adding a 47nF capacitor across collector load of Q1. ♦



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# NEWS HIGHLIGHTS

## FRONT-END CHIPSET FOR EUROPE'S DTTV

NDS, Motorola and Alps have completed collaborative development on and are now introducing what is claimed as the world's first front-end solution for the European Digital Terrestrial Television (DTTV) market. The DTTV front-end solution is a result of an agreement between the three companies, first announced in June 1997, to work together on the design and manufacture of a module to allow consumer receiver manufacturers to quickly and easily produce a set-top box in time for the launch of Digital Terrestrial TV during 1998.

The front-end solution is achieved with three chips which provide Coded Orthogonal Frequency Division Multiplex (COFDM) demodulation, 2K-mode Fast Fourier Transform (2K-FFT) processing, and Forward Error Correction (FEC). The complete chip set is manufactured by Motorola.

The new chipset takes signals from existing rooftop aerials and demodulates them using the DVB-T specification, and outputs an MPEG-2 stream for use in digital TV sets or set-top boxes. The front-end has been designed to receive 2K carrier DVB compliant signals, the profile for DTTV broadcasting in the UK as specified by the d-MUX organisation.

"We are delighted to announce the results of a full evaluation of the demodulation chip set from Motorola and the tuner from Alps together with our own NDS broadcast equipment. The evaluation trials have produced the results needed to enable us to now bring the front-end solution to market", said Dr Mike Windram, senior vice president of NDS and managing director of NDS Broadcast Systems.

NDS has designed the COFDM chip and specified the 2K-FFT processing chip, while Motorola designed and built the 2K-FFT and FEC chips and is building the COFDM chip. Alps has developed the tuner and is also introducing a front-end module.

NDS, headquartered in the UK and with operations worldwide, provides end-to-end solutions for digital broadcasting through the company's research, development and manufacturing activities. It is a recognised leader in digital video compression and conditional access, and has proven systems integration and global support capabilities. NDS is part of the News Technology Group, responsible for News Corporation's high technology companies.

## INTEL MOVES AGAINST CHIP REMARKERS

Intel Corporation and Intel Australia have commenced proceedings in the Federal Court of Australia against Melbourne computer dealer Computer Touch Pty Ltd, Computer Touch director Mr Tony Chau and Typhoon Computer Supplies, claiming that the defendants were involved in the importation and distribution of remarked Intel microprocessors.

A remarked Intel microprocessor is one that has been manufactured by Intel and designated by Intel as capable of operating at a particular speed (i.e., 166MHz, 200MHz or 233MHz), but has had its speed designation increased without Intel's permission. According to Intel, a processor may be damaged if it is remarked in this way, and if it is run at the higher remarked speed, may overheat. Intel's three year limited warranty does not extend to remarked processors.

## SOURCE FOR OBSOLETE COMPONENTS

Maintenance and repair organisations often find that electronic components required for repairs have become obsolete long before the equipment they are needed for has reached the end of its economic life. The user may then be forced to consider expensive board or complete equipment replacement, for the want of a minor and relatively inexpensive component.

US firm NTE Electronics has built its business on solving this problem. The company purchases both 'end of life' and current component production runs from semiconductor manufacturers, and cross-references these to provide industry with a very broad range of replacement semiconductors — covering 260,131 cross references.

Full details of the NTE product range are available in the company's 331-page Semiconductor Replacement Guide, available from Australian distributor Colourview Electronics, PO Box 228, Salisbury 4107; phone (07) 3275 3188.



Tom Iradi, a scientist at the Airtron Division of Litton Industries, examines a large crystal of neodymium-doped yttrium aluminium garnet (Nd:YAG) grown at Litton's facility in Charlotte, North Carolina. Rods cut from such crystals form the heart of solid-state lasers used for eye surgery, industrial cutting and welding, and military range-finding applications. (Business Wire photo)



## ATOM-SIZED DEVICES FOUND ON CARBON NANOTUBES

Scientists with the Ernest Orlando Lawrence Berkeley National Laboratory (Berkeley Lab) in California have confirmed the existence of atom-sized electronic devices on nanotubes, hollow cylinders of pure carbon about 50,000 times more narrow than a human hair in diameter. Nanotube devices have been predicted by theorists, but this is the first demonstration that such devices actually exist.

Alex Zettl, a physicist with Berkeley Lab's Materials Sciences Division and a professor of physics on the University of California's Berkeley campus, led a study in which nanotubes of pure carbon were shown to function as an electronic diode.

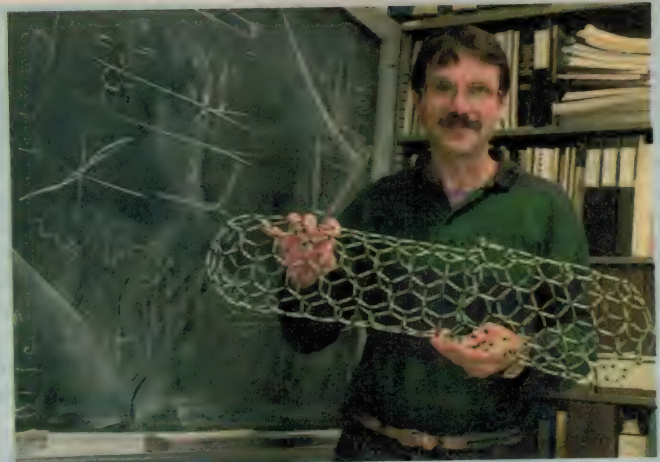
"What we are seeing is the world's smallest room temperature rectifier, one that is only a handful of atoms in size", said Zettl. "When we grow nanotubes, electronic devices naturally form on them."

Past attempts to identify nanotube devices employed submicron-sized electrode contact pads that could only measure small isolated sections of the tube. Evidently, the experimenters were measuring the wrong sections. Zettl succeeded by measuring nanotubes along their entire length. He accomplished this through the use of the ultrafine tip of a scanning tunnelling microscope.

Nanotubes are only a few nanometres in diameter. When made exclusively from carbon molecules, they are chemically inert, about 100 times stronger than steel, and offer a full range of electrical and thermal conductivity possibilities. Carbon nanotubes were discovered by the Japanese electron microscopist Sumio Iijima. They are created by heating ordinary carbon until it vaporizes, then allowing it to condense in a vacuum or an inert gas. The carbon condenses in a series of hexagons, like sheets of graphite, that curl and connect into hollow tubes.

Depending upon its diameter, a pure carbon nanotube can conduct an electrical current as if it were a metal, or it can act as a semiconductor, meaning it will only conduct a current beyond a critical voltage. According to a theory proposed by Berkeley Lab physicists Marvin Cohen and Steven Louie, both also with UC Berkeley, an electronic device could be created at the interface between two dissimilar nanotubes, one that acts as a metal and one that acts as a semiconductor. This would create a 'Schottky barrier', which means the current will only flow in one direction — from the semiconductor to the metal.

Zettl does not expect nanotubes to replace silicon overnight in the electronics industry, but can see this as a possibility down the road. Silicon must be doped with other atoms to make an electronic device. As the size of a device shrinks, the dopant atoms eventually begin to move about, degrading the device's performance. Heat also



**Berkeley Labs physicist Alex Zettl with a model of the carbon nanotube structure.**

becomes a problem despite silicon's good thermal conductivity.

The use of diamond film, with its exceptionally high thermal conductivity, has been proposed to protect silicon-based devices but this adds further complications to the manufacturing process. Size and heat are no issue for nanotubes, because they are covalently bonded (which means their atoms are locked firmly into place) and are predicted to be even better thermal conductors than either silicon or diamond at room temperature.

"Silicon is eventually going to hit a brick wall where devices can't be made any smaller", Zettl says. "Nanotubes are already smaller and don't have a problem with heat. You could not ask for anything better in a material."

Rather than wiring individual devices in nanotubes for specific purposes, as is done with silicon chips, Zettl suggests a better approach might be to make a 'tube cube', a block of nanotubes that would be densely packed with billions upon billions of devices. The tube could then be wired to form a random network of 'nanocomputers'. This random network would be able to train itself to perform tasks, reconfiguring its input/output architecture to improve its performance as it learns and develops. In other words, this random computer would not just get older, it would get better.

"The idea is not as far off as you might think," says Zettl, whose group has already constructed and wired up a tube cube of sorts. The cube cannot yet perform any useful function, but Zettl says it does yield some 'interesting' responses to input signals.

## VISHAY BUYS TEMIC FOR US\$500 MILLION

Vishay Intertechnology Inc., the largest US and European manufacturer of passive electronic components, is acquiring the semiconductor business unit of TEMIC Telefunken microelectronic GmbH of Heilbronn, Germany, whose parent company is Daimler-Benz AG, Stuttgart. The purchase price is approximately US\$500 million and subject to government approvals. The closing will be in March, 1998.

Dr Eckhard Cordes, member of the Daimler-Benz board in charge of Corporate Development and Directly Managed Businesses, stated: "With the sale of its semiconductor business unit, Daimler-Benz continues its strategy to focus on businesses directly related to transportation products, sys-

tems and services. The sale of the TEMIC Semiconductor business to Vishay Intertechnology brings this business into a much better competitive situation. For Daimler-Benz, this disinvestment is a further step to focus the group's portfolio on those businesses we understand. TEMIC Semiconductor is a perfect fit for Vishay."

TEMIC's semiconductor business unit employs 6700 people worldwide, 2000 of which are in Germany. Sales for calendar year 1997 are expected to be approximately US\$875 million. The semiconductor business unit consists of the Integrated Circuits (IC) division headquartered in Heilbronn, Germany and the Discrete Components division headquartered in Santa Clara, California.

In the United States, TEMIC operates Siliconix located in Santa Clara, California and owns 80.4% of the outstanding shares.

## DIY SPEAKER COURSE AT BOX HILL TAFE

Alan Anderson is a loudspeaker expert at Box Hill Institute of TAFE. His interest in electronics and music has led him to design a short course in speaker design and construction. He knows that hifi enthusiasts want powerful, accurate, high-quality reproduction of recorded sound and that they may often go to inordinate lengths to find the best quality product at the best price. Alan's students discover how speakers work, which speaker system is most suitable for their individual needs and how to evaluate commercial product.

The course also teaches how to build sets of speakers using pedigree components, but at a much lower cost than ready made alternatives.

Do you need to be an electronic whiz to do



this course? Anderson says "No. Students come from all sorts of backgrounds. I have had people with no experience in sound systems who are simply looking for purchasing knowledge. Some see it as a do-it-yourself exercise. Some have worked on car radios, in recording studios, are musicians or band equipment techs."

The course runs for two and a half hours on Monday nights over eight weeks and costs \$150. This fee covers training in the theory of a wide range of cross-over systems and uses PC software related to speaker design.

1998 courses begin in February, April, July and October and are held at Nelson Campus, Box Hill Institute of TAFE. For more information contact the Centre of Electronics Engineering, telephone (03) 9286 9830.

### DVB MOVES TOWARD MULTIMEDIA PLATFORM

The Steering Board of the Digital Video Broadcasting (DVB) Project has endorsed a set of functional requirements for running applications on advanced set-top boxes, TV sets and multimedia PCs for digital broadcasting. This is seen as the first step in the development of open technical specifications for a Multimedia Home Platform (MHP), targeted for completion by June 1998.

The goal for DVB is to provide an open solution, enabling multiple service providers to operate through a compatible cost-effective receiver in the home, while fully recognising the investments already made by broadcasters and consumers in existing systems.

Mr Theo Peek, chairman of the DVB Project said "It is an important step forward

for the DVB project, and a major achievement to reach consensus from so many key digital broadcasting industry players on such a complex issue. Platform harmonisation means that any digital content provider will be able to address any advanced set top box, TV set or multimedia PC."

The Digital Video Broadcasting Project (DVB) is a consortium of over 200 broadcasters, manufacturers, network operators and regulatory bodies in more than 30 countries worldwide, committed to designing a global standard for the delivery of digital television.

### SMART MEDIA DENSITY DOUBLED

Toshiba Corporation in Japan has doubled the capacity of its popular SmartMedia removable storage media cards, while retaining their small size and simplicity of use. The first commercial SmartMedia cards using the new technology have a capacity of 16 megabytes, twice that of the largest capacity cards now available, and will debut in 1998.

SmartMedia cards are a highly compact, light, cost-effective data storage cards for personal digital media. They are little over the size of a postage stamp, and their use of a NAND flash memory chip supports high speed rewriting of individual memory sectors. These pluses have already won SmartMedia a central position in such emerging markets as data storage for digital still cameras.

Toshiba's breakthrough doubles card memory capacity while retaining its original size. A control circuit within the NAND chip treats two separate chips as a single chip, while the company's advanced mounting

technology allows the two chips to be assembled on a single printed circuit board and pasted in the base card. The result is doubled capacity in a base card with exactly the same dimensions and contact area.

Toshiba currently produces two, four and eight-megabyte SmartMedia cards, each incorporating a single NAND chip. In the new card scheduled for launch in early 1998, the company has combined two 64Mb NAND chips in a 16MB card that fully meets the specifications published by the SSFDC Forum (Solid-State Floppy-Disk Card Forum) last November. Initial access time is 7 $\mu$ s, with a serial cycle time of 50ns and a typical erase time of 2ms.

### NEW EDITION OF ELECTRONICS YEARBOOK

The 11th edition of the Australia Electronics Yearbook is now available, covering more than 4500 product categories, over 8500 Australian and overseas companies and brands, company logos and Austel Standards, and is said to be a vital tool for anyone who requires a fast and qualified way of accessing electronics supply information. The Yearbook also contains conference, exhibitions and seminars, electronics and electrical associations, quality certification bodies and more.

The Yearbook is comprehensively indexed and provides contact details for all organisations and suppliers — including interstate agents and distributors, address, web site, phone, fax, e-mail and company profile information.

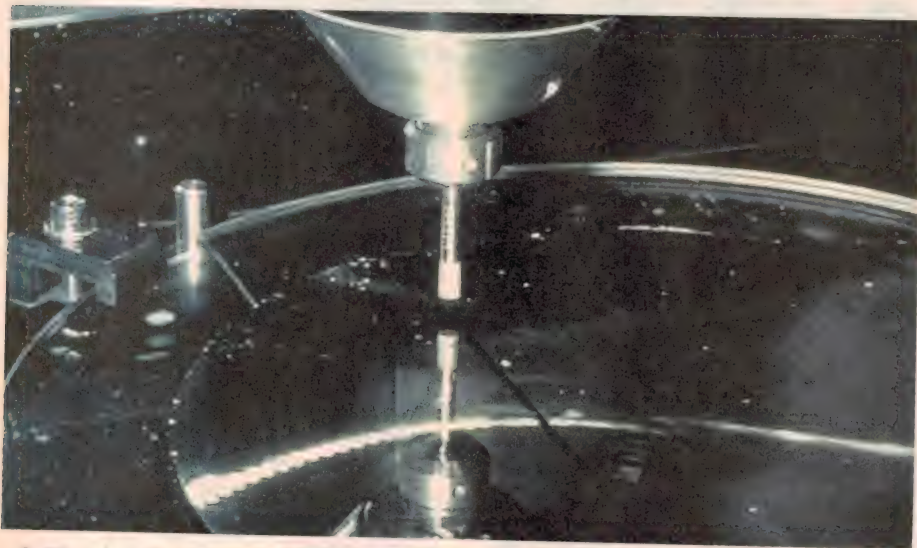
Price of the Yearbook is \$130 and it's available from publisher IHS Australia, freecall 1800 062 299.

### RAMTRON & ASAHI SIGN FRAM AGREEMENT

Ramtron International Corporation has signed an agreement with Asahi Chemical Industry Co of Japan to develop and manufacture Ramtron's ferroelectric random access memory (FRAM) devices.

Under the terms of the agreement, the companies will initially define and develop a prototype embedded FRAM integrated circuit (IC). Upon successful completion of the initial phase, Ramtron and Asahi plan to establish a FRAM memory manufacturing capability at Asahi or its subsidiary. At that time, Asahi has an option to obtain a FRAM memory license from Ramtron for product densities up to 64kb. The agreement also provides for certain future royalty and manufacturing capacity considerations to Ramtron.

In addition to Asahi, Ramtron has FRAM licensing and manufacturing agreements with top semiconductor producers including



*Californian firm Hypervision, which specialises in using emission microscopy to diagnose chip defects, has doubled the speed of its 'Chip UnZip' technology to thin the backside of flip-chip and similar wafers for emission imaging. Shown here is a diamond thinning tool in operation. (Hypervision Inc, 46560 Fremont Blvd Suite 415, Fremont CA 94538.)*



Hitachi, Rohm, and Toshiba and Fujitsu. The agreements provide for royalty considerations, and manufacturing capacity that can be used by Ramtron to develop its own product business. The company also has licensing and/or development agreements with Samsung and SGS-Thomson.

## CANON 300mm STEPPER NOW WORKING AT I300I

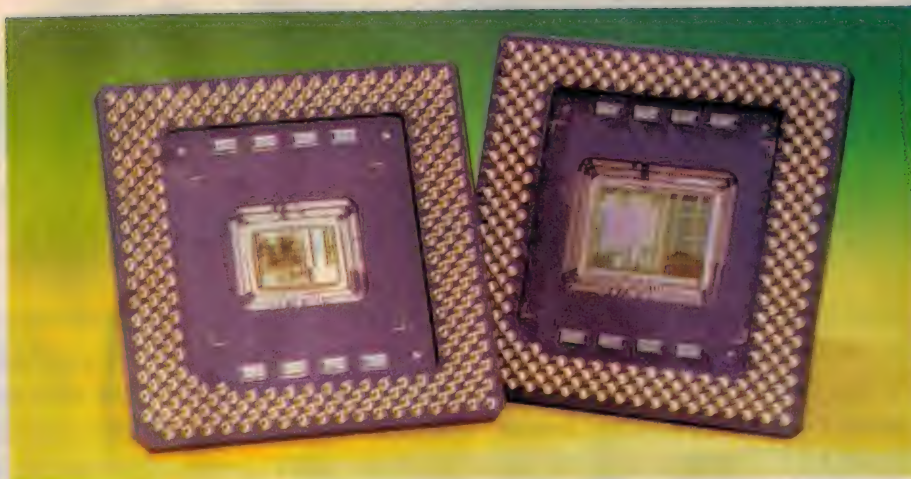
Canon USA's Semiconductor Equipment Division has announced that its 300mm FPA-3000EX3L DUV stepper at the I300I (International 300mm Initiative) facility in Austin, Texas, is now operational and that I300I and Intel have accepted the new machine following a successful performance test in which the EX3L exposed more than 1500 300mm (12") wafers without failure.

"Our goal remains to help our members get a head start on the competitive advantages in productivity and technology that 300mm conversion will bring", commented Frank Robertson, VP and general manager of I300I. "Having a 300-mm stepper donated and in place early helps us stay ahead of the curve on providing information to our members across the globe."

Due to the consortium's limited funding, Intel Corporation purchased the machine for use by I300I under a one-year contract that will allow sharing of resultant data with all member companies. Intel will also develop its own exclusive processes on the stepper.

Daniel Enloe, Intel assignee and director of patterning technologies for I300I, regards the EX3L stepper as a technology enabler. "It will let us keep our many other process demonstrations moving at a good pace. Now we can print feature size down to 0.18 microns with some advance techniques such as phase shift masks, and make more relevant demonstrations for our member companies", Enloe said.

SELETE, a 300mm development consortium of Japanese major IC manufacturers including new member Samsung of Korea, has also installed a Canon EX3L at its facility. The SELETE tool was previously in operation and has been providing valuable



*National Semiconductor's recently-acquired Cyrix microprocessor division is now producing its 6x86MX processor chips using a 0.25um process technology, producing dice 40% smaller than the 0.35um process previously used. Samples of the new (L) and older (R) microprocessors are compared here. (Business Wire photo)*

information for 300mm process development. Two SELETE and I300I member companies also have Canon FPA-3000EX3L steppers in place.

The EX3L is based on Canon's field-proven DUV stepper FPA-3000EX3 platform, with modified 300mm wafer stage. The EX3 platform has an advanced all-quartz lens with a numerical aperture of 0.6 to achieve production resolution of 0.25um over a 22 x 22mm image field.

## MAPPING SATELLITE IN LUNAR ORBIT

NASA's Lunar Prospector satellite is now in a circular 118-minute, 100km orbit around the Moon, and during its one-year polar orbiting mission will map the Moon's surface composition, gravity and magnetic fields, and volatile release activity. It will also measure the existence or absence of water ice in the Moon's polar regions.

"We are extremely pleased with the effort put forth on Lunar Prospector and proud to be a part of NASA's exploration of the Moon", said Mike Henshaw, president of Lockheed Martin Missiles & Space, where the spacecraft was designed and built. "We

put a detailed program in place, met the schedule, and maintained cost control while proceeding from hardware development through spacecraft test in just 22 months. This mission will give NASA more science for the dollar than ever before."

The small scientific spacecraft is a spin-stabilized vehicle with a fully-fueled mass of 663 pounds, is 4.6 feet in diameter and 4.1 feet in axial length, with solar cells mounted on its outer surface providing 206W of power.

## SHARP CLAIMS PROMISING NEW DISPLAY TECHNOLOGY

Japan's Sharp and Semiconductor Energy Laboratory has announced the development of a new type of liquid crystal display (LCD) technology, known as continuous grain silicon. It's claimed the new CGS displays will enable electronics manufacturers to produce calculators, computers and other electronic devices thinner than a credit card.

CGS displays for the first time incorporate both the display, display drivers and other computing circuitry inside the glass display panels. All are produced in a single multi-step manufacturing process.

Sharp president Haruo Tsuji said CGS displays will enable companies to cost-effectively market devices ranging from large, high-speed flat panel computer terminals to small handheld computer and communications devices. Because of the high electron mobility of CGS displays, in which electrons travel about 600 times faster than they do in amorphous silicon TFT LCDs, the new devices are capable of producing images of considerably higher resolution than conventional LCD-based displays.

Sharp has already produced a prototype 60" diagonal CGS display featuring an LCD driver with a speed of 13.8MHz. Initial pilot production will commence in April, with high-volume scheduled for early 1999. ♦

## NEWS BRIEFS

- The ongoing business of Trace Pacific has been acquired by **Barco Systems Pty Ltd**, a private company incorporated in Australia and wholly owned by Barco NV, based in Kortrijk, Belgium. Founded in 1934, Barco is a world leader in projection, display, communication and graphics systems, and automation. The company's Sydney office can be contacted at PO Box 233, Frenchs Forest 2086; phone (02) 9451 6018.
- The Sydney office of **Nilsen Technologies** has moved to Unit 1B, The Boat Ramp, Blaxland Road, Rhodes 2138; phone (02) 9736 3285.
- The 1998 **Perth Electronic Show** will be held at the Burswood Superdome on June 12-14. For more information contact the organiser at PO Box 6, Mt Hawthorn 6915; phone (08) 9444 6310.
- The **AEDC** (Australian Electronics Development Centre) has moved to Level 8, Casselden Place, 2 Lonsdale Street, Melbourne 3000; phone (03) 9662 9244 or 1800 339 601.
- International component manufacturer **BI Technologies** has appointed Sydney-based **BBS Electronics Australia** as its distributor in Australia and New Zealand. BBS is located at Unit 24, 5-7 Anella Avenue, Castle Hill 2154; phone (02) 9894 5244. ♦



# TEMIC's Trench-Gate MOSFETs set new performance standards

There has never been more pressure on the electronics industry to make its products both smaller and more energy efficient. A key part of the industry's success in meeting this twin challenge is the development of power MOSFET switching devices with exceedingly low on-resistance. A leader in developing these devices is TEMIC Semiconductors, which has employed its TrenchFET technology to make devices with on-resistances as low as four milliohms. Here's an insight into this impressive technology, provided by TEMIC's product development engineers.

*Power MOSFET wafer fabrication at TEMIC Semiconductor's fab plant in Santa Clara, California.*



The widespread growth of battery powered portable computer and communication products is making small-footprint power MOSFETs with low on-resistance more important than ever. Primarily used as switches in DC/DC conversion, load switching, battery-pack management and data-storage motor control, the power MOSFET is essential in achieving long battery operating times between charges.

In low-voltage portable products, two trends are emerging:

- an ongoing need for further miniaturization of components, including power semiconductor devices; and
- a reduction in power supply voltages, making efficiency harder to achieve.

At first glance, these trends appear self-evident. But upon closer scrutiny, we can see a complex interdependence between application and technology.

Historically, the migration to smaller package sizes, from the DPAK to the SO-8 and more recently to the TSOP-6, occurred without any sacrifice of performance. Today, further reductions in voltage rails without a corresponding decrease in power consumption have demanded even higher load currents and lower on-resistances — despite a reduced gate bias. Such stringent requirements have pushed the traditional 'planar' DMOS technology beyond its practical and theoretical density and performance limits.

A new alternative to planar DMOS, the trench-gated DMOS or TrenchFET, has performance levels high enough to overcome such limitations, especially when the drain and gate voltages ratings can be independently optimized.

Two new families of TrenchFETs from TEMIC Semiconductors illustrate the benefits of trench power MOSFET technology. With the lowest on-resistance ever offered in small outline packages, both the N- and P-channel versions of these devices lower on-resistance  $r_{DS(on)}$  by as much as half, compared with previous state-of-the-art



power MOSFETs.

Built on a proprietary process yielding die with 32 million transistor cells per square inch — nearly triple the previous record for power MOSFET cell density — the new TrenchFETs are being introduced in two distinct families. One family is targeted at applications with supplies operating from 4.5V to 12V, which include desktop computers and multi-cell battery packs. A second family is targeted at applications with supplies operating between 2.5V and 8V, which include cell phones, portable computers, and one- and two-cell battery packs.

## Architecture & performance

In a power MOSFET, performance is primarily measured by an 'area normalized specific on-resistance' or  $R_{dsA}$  (having units of milliohms/cm<sup>2</sup>). For any given design, this figure of merit describes the inverse relationship between on-resistance and active transistor die area.

Below 100V, the lowest specific on-resistance vertical power MOSFETs use a closed-cell geometric design to form a repeated array of paralleled devices, generally square in shape. By increasing the number of cells used in a given device, its total resistance can be decreased. On-resistance can also be decreased by employing tighter dimensions in each cell (thereby increasing the number of cells packed in a given area), or by lowering the breakdown rating of the device.

To achieve a favourable tradeoff between breakdown and on-resistance, a double-diffused (DMOS) channel profile is employed to maintain a short channel length without punch-through breakdown. While sustaining any substantial voltage, most of the potential appears across the epitaxial drain of the DMOS, keeping depletion spreading into the channel at a minimum. The breakdown of the device is then set by the epi

thickness and doping.

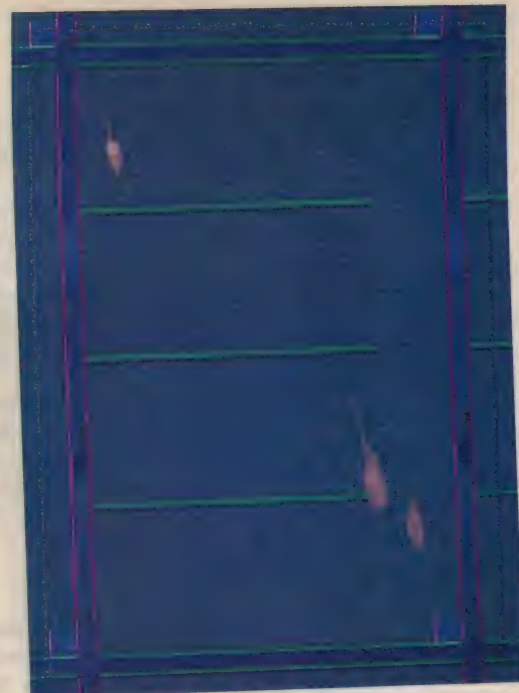
Since the epitaxial drain constitutes a series resistive element in the device, higher voltage devices naturally exhibit a higher resistance. Below 100V, the DMOS on-resistance varies roughly in proportion to  $BV^{2.7}$ , excluding metal resistance.

Most commercially available vertical power MOSFETs are of the planar DMOS variety shown in Fig.1. Currents emanating from the source flow laterally along the surface, then turn and flow vertically away from the surface between adjacent body diffusions, through the epitaxial drain, into the substrate and out the wafer's back-side. The channel is formed under the polysilicon gate layer along the planar surface; hence its description as a 'planar' DMOS device.

Beyond a current state-of-the-art planar DMOS cell density of approximately seven million cells per square inch, further scaling has become increasingly difficult. One of the performance limitations of planar DMOS is the surface area lost for the polysilicon gate electrode. Unfortunately, additional reduction in the size of the gate electrode exacerbates the aforementioned parasitic JFET pinching effect — leading to a higher, not lower, device on-resistance at a small cell pitch (Fig.2). Only by eliminating the pinching effect can cell pitch reductions significantly benefit power MOSFET specific on-resistance.

## Trench gate MOSFET

The trench gated MOSFET (or TrenchFET) shown in Fig.3 overcomes the pinching problem associated with planar DMOS. Instead of conducting current along the silicon surface, the channel is formed vertically along the side wall of a trench

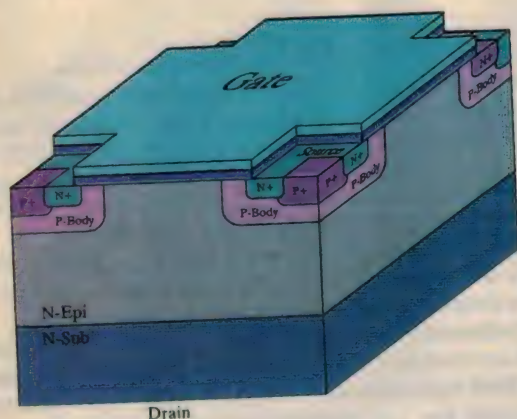


**A 32M cell/square inch TrenchFET die for a TO-220 or D2PAK package. This die has over one million cells.**

etched in the silicon.

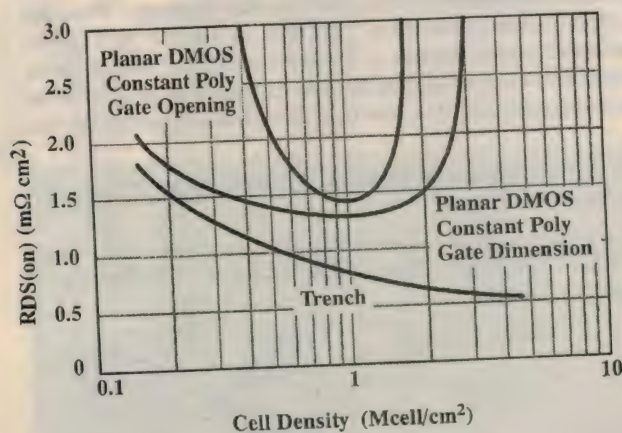
Using a closed-cell pattern similar to that of planar DMOS, the trench forms a grid surrounding islands of silicon. Each silicon island is the location of a double diffused channel region (or body) and its associated source diffusion. The trench is oxidized, then filled with a conductor and planarized to form the gate of the MOSFET.

While the resulting structure is similar to the MOS capacitors used in megabit DRAMs, the electrical requirements of the trench structure in a vertical power device are more stringent because it controls the conduction properties of the device. Moreover, a vertical power MOSFET must



**Fig.1: The structure of a conventional 'planar' DMOS' vertical power MOSFET.**

**Fig.2: Specific on-resistance vs. packing density, for planar DMOS and TrenchFET devices.**





## Technology Backgrounder:

be manufactured *defect free*, since individual cells cannot be electrically removed from the device - as they sometimes are in large memories with built-in redundancy.

To make trench power MOSFETs manufacturable, numerous design, processing and materials issues had to be addressed. As with any breakthrough technology, these hurdles took many years of development to overcome. Challenges encountered include crystal orientation issues with silicon trench etching, oxidation induced stress at concave corners, oxide charge, surface roughness along etched surfaces and gate oxide uniformity.

Another key issue is control of the trench shape. Elimination of sharp trench corners by rounding helps to reduce electric fields and carrier generation at the trench edge. Accordingly, device reliability has been designed-in to this device from its inception.

All in all, the trench gate MOSFET is capable of improved on-resistance at cell densities never before possible.

### New Little Foot devices

The result of such a concerted effort is the latest generation of TEMIC's 32 million-cell per square inch 'Little Foot' TrenchFETs, which provide below thresholds below 1V, low off-state leakage over temperature, high-transconductance and extremely low specific on-resistance even at a 2.5V gate bias.

The curves of Fig.4 illustrate the magnitude of measured on-resistance of these new devices as a function of gate bias. At 10V, specific on-resistance for the new P-channel devices is 0.39 milliohms/cm<sup>2</sup> and 0.18 milliohms/cm<sup>2</sup> for the new N-channel devices. These are the lowest values ever recorded for a production-worthy device, and well below the 0.72 and 0.52 milliohms/cm<sup>2</sup> industry benchmark for 12V gate rated parts (denoted by bars in the graph), previously established by TEMIC's low-threshold seven-million cell/inch<sup>2</sup> planar process.

Specific on-resistance for the new 2.5V rated TrenchFETs is 0.78 milliohms/cm<sup>2</sup> for the P-channel devices and 0.34 milliohms/cm<sup>2</sup> for the N-channel devices, less than half that of the comparable values of the planar process.

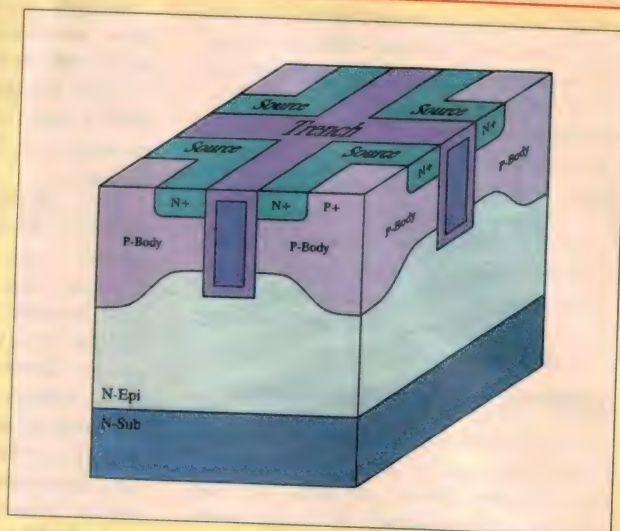
### New design options

The low on-resistance of these new TrenchFETs opens up at least three distinct opportunities for equipment designers:

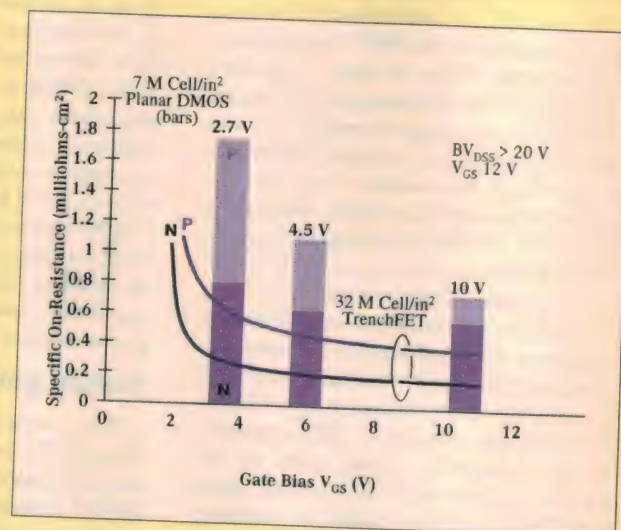
- **Twice the performance from the same package:** A single 9mΩ Si4420DY can now supply the high currents demanded by high performance microprocessors, replacing two SO-8 packages. Since the transconductance is higher and the parasitic capacitances are reduced, it also becomes easier to drive the device at high frequencies — which allow DC-to-DC converters and voltage regulators to be made smaller.
- **The same performance in a much smaller package:** These are the first devices in the SO-8, TSSOP-8, or TSOP-6 packages to have on-resistance this low. A TSSOP-8 or even a TSOP-6 device from these new families can be used to replace an SO-8 with no loss in performance. The new dual devices nearly match the pre-

**Table 1: The ratings of the new devices are optimised for specific applications.**

Drain-Source Voltage	Gate-Source Voltage	Polarity	Main Applications	End Products
20 V	2.5 and 4.5 V	N	switches	Li-ion batteries
		P	load switches	cell phones
30 V	4.5 and 10 V	N	DC/DC conversion	notebook PCs
		P	battery switches	Li-ion batteries



**Fig.3: A cross-sectional view of a TrenchFET.**



**Fig.4: On-resistance of a TrenchFET as a function of gate bias.**

vious single-die 'state of the art' device in performance.

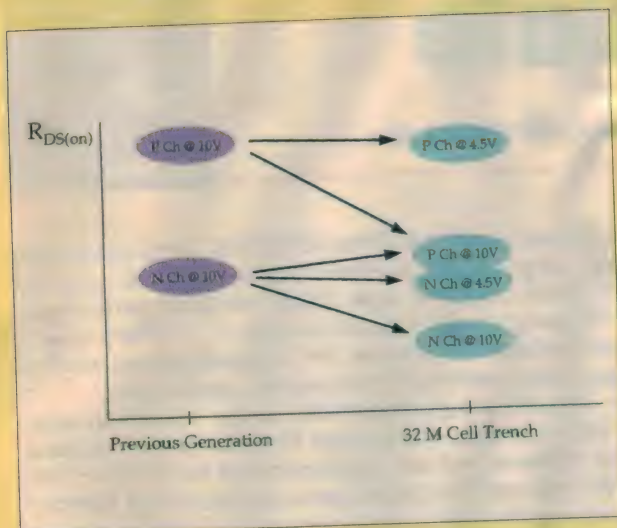
- **Easier high-side switching:** The new P-channel TrenchFETs provide roughly the same on resistance as the best N-channel power MOSFET available a year ago. Substituting a P-channel MOSFET for an N-channel MOSFET facilitates a simpler, less costly gate drive circuit, free of an isolated power supply and easily driven at higher switching rates than a high-side N-channel device.

The drain-source and gate-source voltage ratings of these new TrenchFETs are optimized for specific applications, as shown in Table 1. The following points should make this clear.

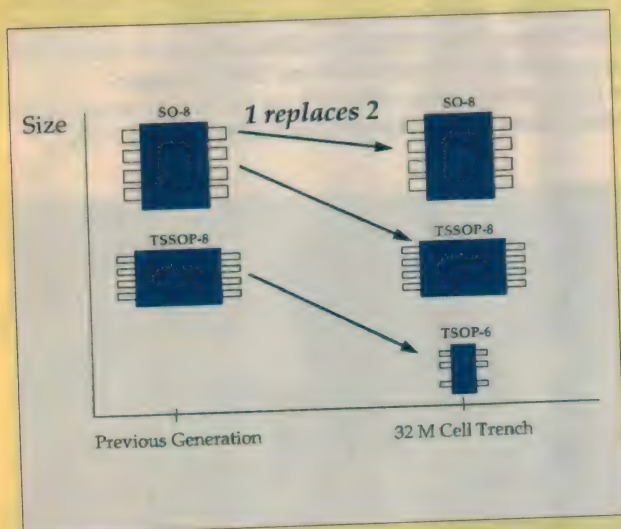
**30V VDS N-channel TrenchFETs with RDS specified at 10V and 4.5V:** These are ideal for DC/DC conversion from 20V to a regulated voltage. Their high cell density reduces parasitic capacitance values; they provide low gate charge x on-resistance, and provide an ideal solution for creating DC/DC conversion circuits with low conduction and switching losses. Dual N-channel and complementary N- and P-channel versions are also available.

**30V VDS P-channel TrenchFETs with RDS specified at 10V and**





**Fig.5: The new 32M cell/square inch TrenchFET technology is opening up new low-voltage applications.**

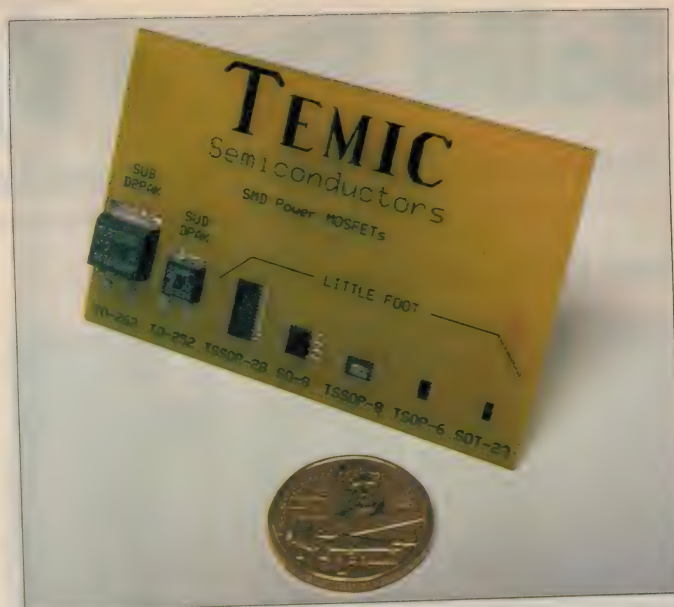


**Fig.6: The lower on-resistance of TrenchFETs allows either twice the performance from the same package, or the same performance from a much smaller package.**

**4.5V:** The 30V breakdown voltage rating makes these devices ideal for any application on the battery rail of a notebook PC, which is typically 20V maximum. They can be used for switching between two batteries, or to disconnect a battery; to convert the battery voltage to a regulated voltage in a DC/DC converter; or used in the battery pack itself as a safety switch to avoid overcharging the battery.

**20V VDS N-Channel TrenchFETs with RDS specified at 4.5V and 2.5V:** These have industry's lowest on-resistance at a 4.5V or 2.5V gate drive, for any package style. They are ideal for use as a low-side switch or safety switch in Li-Ion battery packs; the on-resistance rating at 2.5V is critical for single-cell Li-Ion applications where the cell voltage drops to 2.5V. These products have the low on-resistance at 2.5V but also have a 12V maximum, making them very rugged in this safety-related application.

**20V VDS P-channel TrenchFETs with RDS specified at 4.5V and 2.5V:** These again have industry's lowest on-resistance at a 4.5V or 2.5V gate drive for any package style; they are ideal for use as high-side switches and other applications on a 3.3V or lower rail. They are



**A small PCB with samples of some of the tiny packages now able to be used for power MOSFETs, thanks to TrenchFET technology. An Australian dollar coin is shown for comparison.**

commonly used in notebook PCs to disconnect a part of the system when not in use, also in cellphones to switch the battery power and to disconnect parts of the circuit (particularly the power amplifier).

## P-channel TrenchFETs

It should be noted that high-side devices (connected to the '+' terminal of the battery) are common in many applications, from battery switching in a notebook computer to driving lamps and solenoids in the automotive environment. While N-channel power MOSFETs are well known for their low on-resistance and minimal cost, driving the gate of an N-channel MOSFET connected as a high-side switch (HSS) is more difficult and costly than driving a P-channel device. Unlike an N-channel HSS, which requires a charge pump, a floating gate buffer and a high-voltage signal level shifter, the P-channel HSS device only requires level shifting to drive its gate.

However while P-channel power MOSFETs have always been attractive for their ease of use in HSS applications, their on-resistance is higher than that of a comparable N-channel device. Given the technological advancements of trench power MOSFETs, P-channel trench devices now available provide performance equivalent to the best N-channel devices available just a year ago.

Historically the performance of a P-channel MOSFET has been 2.5 to three times worse than a comparable N-channel device, due to the mobility difference between holes (the majority carrier in a P-channel MOSFET) and electrons (the N-channel majority carrier). When comparing the resistance of power MOSFETs, this relationship remains a valid assumption as long as the sum of MOSFET channel and epitaxial drain resistance dominates the total resistance of the device.

For TrenchFETs, however, this assumption is not valid. In a situation similar to the condition when planar MOSFETs are scaled to very low breakdown voltages, exceedingly small channel and drain resistance in a power device makes the substrate resistance and package resistance (including bond wires) non-negligible.

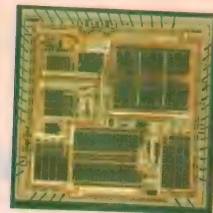
Interestingly, these two components of resistance are not dependent on device polarity. As they constitute an increasing percentage of the total device resistance, the performance of N-channel and P-channel power MOSFETs can be expected to converge.

Further information on TEMIC's TrenchFET devices can be found on the Company's Website at <http://www.temic.com>. ♦



# Solid State Update

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## New 12-bit, 10MHz sampling ADC



Burr-Brown's new SpeedPlus ADS804 is a high-speed, high dynamic range, 12-bit pipelined analog-to-digital converter (ADC) which combines high SFDR and SNR performance with low power dissipation and low cost. It's claimed to offer the best performance solution for communications, medical imaging, video, and test instrumentation applications.

The ADS804's high bandwidth, linear track/hold minimizes harmonic distortion through Nyquist. It also features an internal reference and can be programmed for a 2Vp-p input range for best spurious performance and easy input interface. Alternatively, the 5Vp-p input range can be used for the lowest input referred noise of 0.09 LSB RMS.

The ADS804 employs digital error correction techniques which provide the resolution required for demanding imaging applications. Other key specifications include 80dB SFDR at Nyquist, 69dB SNR, low power (180mW) and low DLE ( $\pm 0.3$ LSB). The device is available in 28-pin SSOP and SOIC packages.

For more information circle 271 on the reader service card or contact Kenelec at 2 Apollo Court, Blackburn 3130.

## Video codec uses wavelet compression

The new ADV601LC video codec from Analog Devices is expected to ignite the consumer market for integrated digital video recording, editing, and playback. Applications such as digital VCRs, TV set-top boxes with instant replay, a wide range of home video editing and other record and playback applications will be made feasible by this relatively low cost device.

The ADV601LC draws on wavelet compression and decompression technology to operate both as a video encoder, which compresses video, and a decoder, which expands the same video to its original form. The chip attains compression ratios ranging from a visually lossless 4:1, suitable for professional studio applications, all the way up to an impressive 350:1, suitable for less demanding surveillance applications. It can compress 25 minutes of VHS-quality video to fit in one gigabyte of space.

The ADV601LC conforms to the CCIR-601 international standard for representing studio-quality digital video, and can



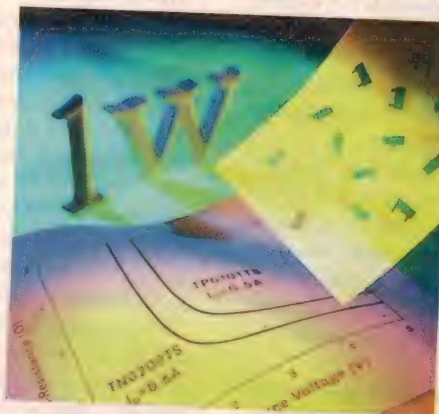
be used in a range of field sizes and field and pixel rates, yielding high-quality results in both NTSC and PAL equipment.

For more information circle 272 on the reader service card or contact Analog Devices, PO Box 2098, Rosebud Plaza 3939.

## Higher power SOT-23 MOSFETs

A pair of new small-signal MOSFETs with triple the power dissipation of previous-generation SOT-23 devices has been released by TEMIC Semiconductors. The new TN0200TS (N-channel) and TP0101TS (P channel) can handle approximately 65% more current than the standard TN0200T and TP0101T, filling a niche between traditional small-signal parts and more expensive power MOSFETs.

The new devices will be used in desktop computers, small DC/DC converters, cell-phones, transmitting pagers, and high-



capacity tape drives and floppy drives where designers need the extra margin of

reliability provided by a 1W rated SOT-23 MOSFET. Specified for operation at 2.5V and 4.5V gate drives, the new devices are rated for maximum currents between  $\pm 0.9$  and  $\pm 1.2$ A. On-resistance at a 4.5V gate drive is a low  $0.4\Omega$  for the N-channel TN0200TS and  $0.65\Omega$  for the P-channel TP0101TS.

To create these new devices, TEMIC maximized pad sizes to handle a larger MOSFET die and used a copper lead frame in the SOT-23 package instead of the traditional Alloy 42.

For more information circle 273 on the reader service card or contact distributors Braemac or Avnet VSI Electronics.



## Fully integrated buck converter

Harris Semiconductor's HIP5020 Buck Converter steps down a DC battery voltage input of 4.5V - 18V to a regulated system voltage of 3.3V or less, and delivers up to 3.5A at greater than 90% efficiency. The HIP5020 is a synchronous buck converter and uses a pair of MOSFETs to switch current, instead of a standard buck converter's MOSFET and Schottky diode. Harris says this represents the most efficient buck regulator topology because the voltage drop caused by a MOSFET's

saturated channel resistance is less than the forward voltage drop of the Schottky at rated current. By including both MOSFETs on the same die as the controller and driver, the HIP5020 allows simpler complimentary MOSFET switching than a non-integrated synchronous buck converter.

In order to assist design engineers using the HIP5020, Harris Semiconductors also offers free simulation software that enables the design of a power supply in 10 minutes. The QuickDesign Simulation software is available from the Harris Semiconductor Internet Site



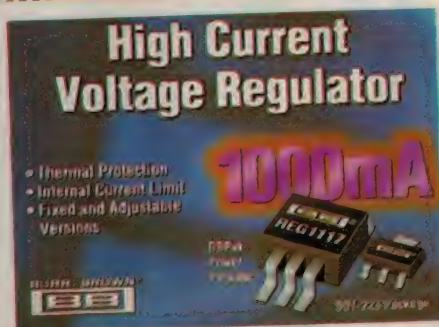
(<http://www.semi.harris.com>).

For more information circle 275 on the reader service card or contact BBS Electronics Australia, Unit 24, 5-7 Anella Avenue Castle Hill 2154.

## Low dropout regulators in DDPAK

Burr-Brown's new REG1117FA and REG1117F-3.3 are additions to the Company's popular REG1117 series of low dropout voltage regulators. Both of these new products come in a surface mount DDPAK power package, which has one-fourth the thermal resistance of the SOT-223 package — allowing higher output current and/or higher input voltage.

REG1117FA is an adjustable-output voltage version capable of delivering



1A (output voltage is set with two external resistors). REG1117F-3.3 has

a fixed 3.3V output and can source up to 800mA. Both versions feature low dropout voltage, internal current limit, and thermal shutdown. In addition, they provide excellent regulation over variations in line, load, and temperature.

The devices are available in the three-lead DDPAK surface-mount and space-saving SOT-223 surface-mount packages.

For more information circle 277 on the reader service card or contact Kenelec at 2 Apollo Court, Blackburn 3130.

## Improved two-wire thermal watchdog IC

An improved two-wire thermal watchdog, a device widely used in personal computers and other systems to monitor CPU temperature, is available from Dallas Semiconductor. The new DS75 device is a drop-in replacement for the popular National Semiconductor LM75, but the Dallas device is claimed to provide important advantages in resolution and power supply range.

The DS75 monitors CPU temperature to protect systems from the excessive heat that can destroy microprocessors. When the temperature exceeds a

set point, the watchdog transmits a signal that powers down the system or turns on a fan.

The industry-standard sensor offers only 9-bit resolution, but DS75 users can change the default value of 9 to 10, 11 or 12 bits by changing two bits in the SRAM configuration register. With 9-bit resolution, a temperature change of 0.5°C is required before the device reports an increase or decrease. With 12-bit resolution, the step size is just .0625°C.

The DS75 reads and writes data over an addressable two-wire serial interface, making multipoint sensing possible on a single two-wire bus. This capability

allows the DS75 to monitor CPUs, power converters, PCMCIA sockets, video drivers, and docking stations. Additional applications include printers, fax machines, copiers, and any microcontroller-based, thermally sensitive system.

For more information circle 278 on the reader service card or contact Dallas Semiconductor, 4401 S. Beltwood Parkway, Dallas Texas 75244-3292 USA. ♦



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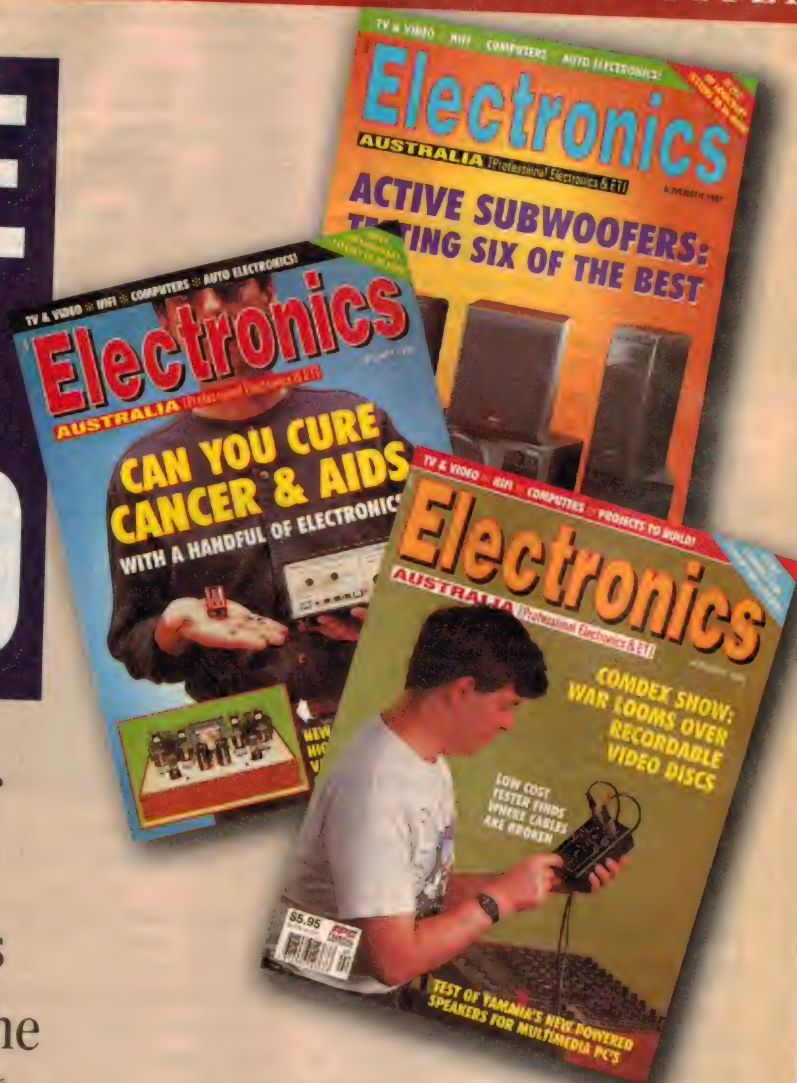
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**THANK GOD FOR THE SALVOS**



# CABLE TESTER FROM ALTRONICS

Altronics Distributors have come up with a cable tester capable of checking for breaks, shorts and phase reversal in almost any audio lead terminated in an XLR, RCA or 6.35mm phono plug. Available in either kit form or as a built-up unit, the tester is quite sophisticated, but did seem to have a few slight problems...

by GRAHAM CATTLEY

If you've ever tried to find a break in an audio cable out in the field, you'll know what an unsatisfactory experience it can be. Trying to keep a pair of meter probes on the correct set of contacts while wiggling the cable with your third hand gets to be a mite difficult, and when think you've found the fault it's more than likely that it's just one of the probes that slipped...

How much nicer then to have a dedicated cable tester, where you just plug in the cable and press a button — no fuss, no swearing and all lines in the cable tested at once. Well, here it is. The Altronics Audio Cable Tester measures 197 x 112 x 60mm and has a range of sockets on its front panel for checking any audio cable terminated in XLR, RCA or 6.35mm plugs, whether they be stereo, mono, balanced or unbalanced. It can check cables terminated in different plugs (say a phono to XLR patch lead), and will even indicate phase reversal as well — very useful, particularly in larger setups with more than one microphone.

The state of the cable is represented by three tri-colour LEDs, one for each line in the cable being tested. These LEDs glow green for continuity (OK), red for open, or orange for shorted. A stereo/mono toggle switch lets you switch off the third LED for mono cables, to prevent confusion.

Being battery operated, there's even a low battery indicator to let you know that the battery is going flat — quite vital, as we found out...

Inside the case everything is very neat and tidy, with a lot of work obviously having gone into the tester's construction. The single circuit board is mounted vertically, and is supported by the four XLR sockets mounted on the punched steel lid.

## Pause for a break

It just so happened that I had a couple of dodgy audio cables knocking around, a mono phono-to-phono with a break, and a three-way XLR microphone lead with an intermittent.

The Cable Tester identified the break in the mono cable straight off, and when I test-

ed the XLR cable I was able to move the length of it around until one of the green LEDs flashed red, indicating that the intermittent was in line 2.

The tester has had a fair amount of use since it arrived here at EA, checking the large number of cables that have accumulated in the back room, and in using it for a while we discovered a couple of small points. The first is that you can get erroneous results if a stereo cable is checked with the 'lead select' switch in the mono position. A note to this effect appears in the tester's two page instruction leaflet, although they say that the wrong readings will occur with a *mono* lead used with the unit in *stereo* mode.

In my tests I found that the problem occurred if a stereo cable with pins 2 and 3 (or 1 and 3) shorted together was tried with the tester set to mono. This would give you an 'Out of Phase' or 'line 1 OK' instead of the correct shorted indication.

More problems surfaced when I tried going through all the possibilities of shorts, breaks and line transpositions. It passed all tests with breaks in one line, two lines, and shorted lines (so long as the mono/stereo switch was set correctly), but after going through the line transposition tests, it seemed that the tester needed line 1 (which is nearly always used for the ground connection) intact to work correctly. If line 1 was swapped with any other line an incorrect reading appeared on the LEDs.

It was only when confirming all the tests I had made that I realised that a wrong reading was being given for pins 2 and 3 transposed. This is a bog standard 'out of phase' lead, and yet the tester didn't pick it up. Strange, it had done so earlier...

It transpires that if the tester's supply voltage falls below 8.5 volts, this one test fails and gives the wrong reading — hence the low battery indicator. Sure enough the Low Battery LED was on, and once a fresh battery was installed the LED went out, and the phase reversal test worked correctly again.

The Cable Tester draws around 25mA when in use, which is a bit steep from a 216-type battery. So it isn't surprising that after



testing a dozen or so cables, the battery voltage dropped by half a volt. Perhaps in a real situation where you might test a cable once a month or so this problem may not arise for some time, but I do feel that the instructions could have let you know that if the battery light is on, an out of phase cable will read incorrectly. ♦

## Altronics Audio Cable Tester

**Good points:** Fast and easy way to test nearly all audio cables.

**Bad points:** Confusing if you aren't sure if a cable is mono or stereo; out of phase test fails if battery isn't fresh. Battery drain is fairly steep.

**RRP:** \$139 for the built-up unit, \$69 for the kit.

**Available:** Altronics Distributors, 174 Roe St., Perth WA 6000. Phone (08) 9328 2199 or fax (08) 9328 4459.





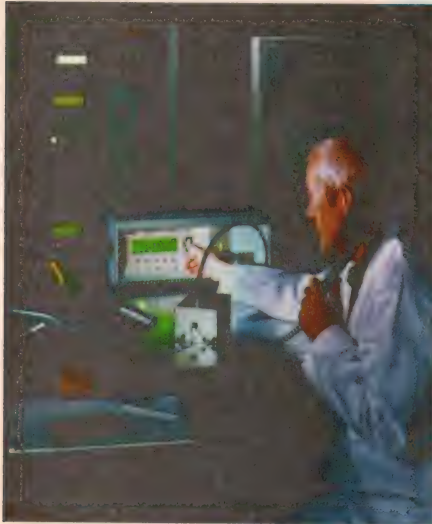
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# NEW PRODUCTS

## Self-calibrating RF simulator for EMC



The new microprocessor controlled Schaffner NSG 2070 high frequency generator provides comprehensive electromagnetic susceptibility testing. Electromagnetic susceptibility tests, although not yet mandatory in Australia, are often required to be conducted for medical apparatus and also for equipment intended for export. It is also expected that IEC susceptibility standards for mobile phones and other equipment, currently in draft stage, will be introduced in the near future.

The NSG 2070 comprises a 100kHz - 250MHz synthesizer, 85W power amplifier (higher power levels can be achieved by means of a secondary power amplifier) and a range of coupling options including capacitive coupling networks (CDNs), electromagnetic clamps, a current injection probe (CIP) and an external monitoring probe.

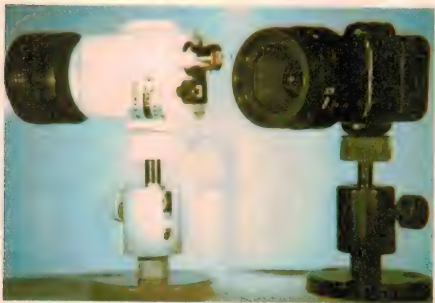
In anticipation of new IEC standards for equipment such as mobile phones, a pulsed mode of operation is already included as standard, making the instrument an excellent investment. It automatically adjusts the output and creates its own calibration table, using output measurements made at the rate of 900 per decade.

A liquid crystal display and keypad provide access to all the functions. A Windows-based software package, WIN 2070, provides setup of all front panel functions in a range of options including test customisation, optimisation and sequencing. Entire test procedures can be saved, and compliance reports can be produced automatically.

For more information circle 247 on the reader service card or contact Westek Industrial Products, Unit 2, 6-10 Maria Street, Laverton North 3026.

## 'Real' dummy cameras

Allthings Sales & Services are now able to supply 'real' dummy video cameras, which differ from most com-



mon cheap looking and quite obvious imitation cameras, by providing a genuine camera housing with standard power input and video output sockets, a standard lens, a standard aluminium swivel mounting bracket and depending on type, come complete with a serial number label.

The two CS (CS is a commercial CCTV lens and mount specification) Dummy Cameras are available in either black or off-white, and both may be converted into a real camera by the addition of a PCB Module Kit.

Also available are Dummy Ceiling Domes, consisting of a standard off-

white mounting base, clear dome and internal opaque mask. A Mini Camera is available which may be easily fitted into the Dummy Dome to convert it into a 'live' unit.

When a CS dummy camera is converted to a real camera it may be fitted with any of a wide range of lenses and has manual pan/tilt adjustments of greater than 360/180°. Dummy Dome Cameras are only \$25 and Dummy CS Mount Cameras only \$69.

For more information circle 245 on the reader service card or contact Allthings Sales & Services, phone (08) 9349 9413.

## Compact AC-DC converters

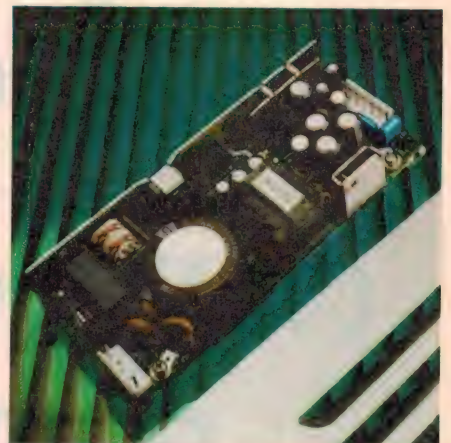
Melcher's MWE family of AC-DC converters have a very compact construction and are available with three or four outputs in the power ranges 17.5, 31 and 51W. The universal input voltage range 85 - 264V AC and the flexible load distribution at the three individual outputs make it possible to choose an optimum power supply for special requirements.

Exceptionally high reliability is achieved through MOSFET technology and the use of a minimum number of components operated at levels well

below their maximum capability. All models of the MWE series are designed for natural convection cooling and are available in a wide variety of output configurations with 5, 12, and 15V DC.

These reasonably priced AC-DC converters comply with international safety standards EN 60950 (IEC 60950) and UL 1950 as well as CSA 950. The EMC is according to VDE 0871 Class A/B.

For more information circle 248 on the reader service card or contact Scientific Devices Australia, 118 Atkinson Street, Oakleigh 3166.





## Benchtop DMM has large LED display

The new Thurlby Thandar 1604 benchtop multimeter is a highly versatile, smart instrument which has features including minimum/maximum value storage, a novel 'T-hold' function enabling the automatic storing of new test point data, and frequency measurement to 40kHz. The 1604 is provided with an isolated RS-232C interface for connection to a PC, and data logging software is also available.

The meter has a basic digital resolution of 40,000 counts (4-1/2 digits), and an accuracy of 0.08%. Voltage, current, resistance and frequency resolutions are respectively 10uV, 0.1uA, 10mΩ and 0.1Hz. All measurements are true RMS and cover the audio bandwidth and higher frequency components of switching waveforms.

The Thurlby Thandar 1604 has a highly convenient, easy



to read display and a robust construction. Operator convenience is assured through a multi-position tilt stand, assuring easy reading of the display.

For more information circle 243 on the reader service card or contact Nilsen Technologies, 150 Oxford Street, Collingwood 3066.

## Low cost UHF data modems

Australian designer and manufacturer Trio Communications 2000 has released a new range of compact data radio modems. The new S series data radios are for use in point to point and multipoint radio data systems in the 400-520MHz and 800-900MHz frequency range. Trio has a background of seven years as manufacturers of GMSK data radio modems, and the S series embodies features

required for stable, error free data communications in a package measuring only 67 x 93 x 25mm.

Designed as a true data-ready radio for GMSK9600 modulation, the S series is said to provide a new benchmark for price, performance and size. Users can buy the radio with an in-built modem of 1200/2400/4800b/s, while OEM and system builders are able to buy the radio only and integrate it with their own modem systems.

Applications for the S series include SCADA, security

control/monitoring and robotic control. Various models are available to a stability of better than 1ppm and capable of a power output adjustable to 5W. The data radio series is designed to meet the world's most stringent technical performance criteria and has the appropriate FCC approvals for parts 101 and 15 in the point to multipoint 900MHz band.

For more information circle 242 on the reader service card or contact Trio Communications at 41 Aster Ave, Carrum Downs 3201. ♦

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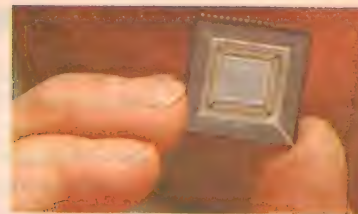
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# Silicon Valley NEWSLETTER



## Japan claims chip breakthrough

Researchers in Japan have announced the development of new technology for a key step in the semiconductor manufacturing process, which may enable chipmakers to produce components with features as small as 0.05µm (microns) compared to current state-of-the-art techniques which allow for 0.25 to 0.18µm features.

The team of researchers from Kyoto University, Fujitsu Laboratories and Japan Science and Technology Corporation said their new so-called 'cluster ion-beam implantation' doping technique could be commercialised within the next four years. Chips with 0.05µm features would increase the performance of existing semiconductors by a factor of more than 60.

While promising, analysts said it remains to be seen if the process, like most innovations in advanced IC production, can be transferred economically to a high-volume production environment. Also, the success of any breakthrough in chip manufacturing is dependent upon similar strides made in other critical production process steps, such as lithography and chemical deposition.

## Intel joins broadcasters on digital TV/PC format

Less than six months after it joined Compaq and Microsoft in urging television broadcasters to adopt the PC display format in their digital TV broadcast signal, Intel effectively ditched the partnership and offered broadcasters a new integrated digital TV display standard that adheres closely to the format broadcasters have already adopted for their next generation of digital televisions.

Intel said the proposed standard will enable manufacturers to build a new generation of smart TV sets with interactive features that will allow consumers to surf the Internet, watch their favourite TV shows or work on computer applications.

Intel's new 'Open Digital Broadcast Initiative' allows broadcasters to choose from several transmission formats. Intel officials demonstrated how it could mix

television signals along with data by blending Internet standards with TV compression techniques. They showed how TV will be able to handle video games and other interactive programs over broadcast signals delivered by cable, satellite or earth-based air waves. The digital broadcast technology would play on a variety of operating systems and computer chips, not just those from Intel and Microsoft.

Intel said the receiving devices could be incorporated in TV set-top boxes at various prices. Some would be fully integrated TV/PC systems and have enough data storage to let consumers store rented movies and record television for later viewing. "Your PC will watch TV for you", said Mike Richmond, business unit manager of broadcast products at Intel's Consumer Products Group.

In addition to the broadcast community, Intel will also have to try to get Compaq and Microsoft on its side. Both may oppose the Intel solution, as it

would make the base cost of computers compatible with the Intel standard more expensive to produce, due to the additional chips and other design issues.

## Hitachi & SGS working on superchip

Hitachi and France's SGS-Thomson Microelectronics are to jointly develop a next-generation version of Hitachi's SuperH microprocessors, for consumer electronics and multimedia applications. The chip, planned to hit the market in 2000, will feature SGS's 64-bit processor design and be built using 0.15µm design rules.

Company officials estimate it will cost in excess of US\$100 million to design the core of the new processor, which will have operating speeds in excess of 1GHz. "By collaborating we aim to establish an industry standard processor for embedded systems, just as the X86 processor family is the industry standard for personal computers", said SGS-Thomson president Pasquale Pistorio.



*At this year's Consumer Electronics Show in Las Vegas Intel demonstrated a Ford Expedition loaded with its in-car computer technology, based on its Pentium processor with MMX. Drivers can find the shortest route to their destination via voice-activated navigation, or make a cellular phone call. Back-seat passengers can watch a movie, play a computer game or surf the Web...*



The chip, which is aimed at the market for embedded processors, will be used for applications ranging from car navigation systems, personal digital assistants, multimedia television decoders and Internet access devices.

## 300mm fab plant for Dresden, Germany

Germany's Siemens and Motorola have announced that they are teaming up on the development of new semiconductor production techniques based on 300mm wafers. The first 300mm pilot production plant to be built by the alliance will be located in Dresden, in eastern Germany.

"Siemens and Motorola have been evaluating the complex technical challenges associated with the move from 200mm to 300mm wafer manufacturing technology, and their possible collaboration. The formative period has now been completed", Siemens officials said.

The 300mm wafer fab development project is expected to gain about US\$100 million in annual subsidies from the German government for the next two or three years.

## Intel still tops the chip market

Intel controlled an astonishing 14.3% of the worldwide semiconductor market in 1997, as the Santa Clara chipmaker's revenues grew 18.5% to US\$21 billion. The overall chip market grew only 5.5% to US\$150 billion, according to industry analyst Dataquest.

The continuing crisis on the DRAM memory market severely impacted the financial performance of most memory-dependent chipmakers. NEC's chip sales grew just 2.2% to US\$10.1 billion and Motorola was the third largest chip maker at US\$8.1 billion in sales, a 0.5% increase from 1996. Only Texas Instruments showed considerable improvement, jumping from sixth to fourth place with an 8.5% sales growth to US\$7.7 billion. Toshiba ranked as the number five chipmaker with US\$7.5 billion in semiconductor revenues (a 7% decline), while Hitachi's chip sales dropped 19.2% to US\$6.5 billion.

## Sun to support Intel's Merced chip

Sun Microsystems has moved to hedge its bets in the workstation processor market by announcing an alliance with Intel, in which Sun will support Intel's 64-bit 'Merced' microprocessor — due out in 1999. Sun officials emphasized that the company is also committed to continue to rely on its own

## Clinton awards Internet founders

Twenty five years ago, Vinton Cerf and Robert Kahn were trying to connect military computers by radio, satellite and telephone wires. The result of their work was the TCP/IP network protocol that today forms the backbone of the global Internet, now connecting more than 100 million computers. Now US President Bill Clinton has bestowed the country's highest science and technology award upon the two engineers. Cerf and Kahn were among 14 scientists receiving the technology award. Previous winners include Microsoft chairman Bill Gates and Gordon Moore, co-founder of Intel.

Cerf and Kahn said they never envisioned their networking application would mushroom into a global network that connects everything from supercomputers to cell phones to kitchen appliances. "All we were thinking about was getting these three damn networks (telephone, satellite, radio) to work together", said Cerf, who is now senior VP at MCI Communications.

"It was a very small-scale scientific problem: how do we get machines on different nets to work together", added Kahn, who is president of the Corporation for National Research Initiatives.

The TCP/IP protocol allows different types of computers running different software to exchange information without any central, top-down control. Contrary to popular myth, Cerf said their project goal was not to help the network survive a nuclear attack, but rather to allow computers to be connected quickly in a war situation over radio and satellite links without a predesigned plan. "This was a self-organizing network. It was intended to be sort of dropped out of the backs of airplanes with parachutes, land on the ground and organize itself because you couldn't plan what the topology was going to be."

It took more than 20 years for TCP/IP to develop into a widely recognized industry standard. The military's ARPANet, the first network to use TCP/IP as its backbone, was nearly terminated on many occasions for lack of additional funding commitments.

SPARC-based RISC processors for the foreseeable future.

"This agreement does not change our hardware strategy at all, and we remain totally committed to SPARC", said SunSoft President Janpieter Scheerder.

Under the terms of the agreement Sun will make an IA-64 version of its Solaris operating systems available. The software should be ready to ship at the same time the Merced hits the market.

Hewlett-Packard, which helped Intel design the Merced, has already announced that it is shifting its entire workstation and business computer strategy towards Merced-based systems running Windows NT.

## Japan's foreign chip share grows again

The huge leap in the foreign share of Japan's semiconductor market is apparently ongoing. During the second quarter of last year, the share held by non-Japanese chipmakers grew to a record 35.8% from 32.6% in the first quarter, according to the US Trade Representative's Office.

"During the four quarters that the US Government has been calculating the foreign market share under the August 2, 1996 semiconductor accords, foreign share has risen to an average 31.2% compared with an average 27.3% during the last four quarters of the 1991 US-Japan semiconductor agreement", said US Trade Representative Charlene

Barshefsky. Higher sales by US and South Korean chipmakers into a flat Japanese market were behind the recent rise in foreign market share, Barshefsky's office said.

## Consumers force end to 56K modem war

In a surprise move, Rockwell International and 3Com reached a peaceful settlement in their battle over a new high-speed modem industry standard. The first PCs and modems using the new 'universal' 56K data transmission standard were expected to be in stores as early as April. Software-based upgrades will also be available for current 56K modem users.

The compromise came just days after the International Telecommunications Union (ITU) announced that it had agreed on two key provisions in a compromise standard. Following the agreement between Rockwell and 3Com, the ITU was expected to approve the provisions and related minor issues at a January meeting before ratifying the specifications in September.

The main credit for getting the two companies to settle their differences lies with consumers, who have largely held off buying the new high-speed modems until the compatibility issues were settled. As a result, modem prices plunged and 3Com and other modem makers saw their warehouses swell with unsold inventories of the devices. ♦



# Computer Accessories

## 19-slot PCI/ISA segmentable backplane



The AP-PSL19S is a 19-slot PCI/ISA segmentable passive backplane which conforms to the PICMG standard (PCI Industrial Computer Manufacturers Group) standard and is constructed from a four-layer PCB. It also has a heavy duty terminal block connector for industrial power supply wiring and LED power indicators for +5V, +12V, -5V and -12V.

Possible configurations are: 5-5-9 (two ISA and one PCI systems), 10-9 (one ISA and one PCI systems), 5-14 (one ISA and one PCI systems) and 19 (one PCI systems).

With a size of 417mm x 260mm the AP-PSL19S is very suitable for use in the IAC-C820A 19" Multi System Chassis, which can support up to four systems at the one time.

For more information circle 204 on the reader service card or contact Intelligent Systems Australia, PO Box 118, Berwick 3806.

## VX Pentium card has display module

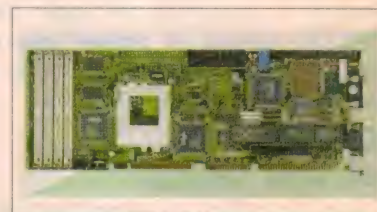
The AP-50IFV is a full-size CPU card designed with the latest Intel 82430VX PCIset chipset, developed by Intel Corporation to fully support Intel Pentium PCI/ISA systems. Its six-layer printed circuit board combined with noise-tolerant

and low power consumption CMOS technology to make it able to withstand any harsh industrial environments very well.

The AP-50IFV is a full-function CPU card which allows the use of VGA and other enhanced I/O interfaces. By using the brand new C&T 65550 video controller, the AP-50IFV is capable of driving CRT and flat panel displays simultaneously, and supports a wide variety of monochrome and colour Single-Panel, Single-Drive (SS) and Dual-Panel, Dual-drive (DD) standard and high-res passive STN and matrix TFT/MIM LCDs, and EL panels.

Besides the video controllers, there are two enhanced FIFO 16550 serial ports, one high performance multimode parallel port, two PCI IDE interfaces for up to four IDE devices, and one floppy disk drive controller.

For more information circle 205 on the reader service card or contact Intelligent Systems Australia, PO Box 118, Berwick 3806.



## Laplink for NT4

Now available from local retailers and resellers, LapLink for Windows NT adds even greater value to Traveling Software's family of highly regarded remote access products, offering powerful new features for Microsoft Windows NT 4.0.

Like LapLink for Windows 95, the NT version is designed

## Barcode reader is attendance terminal

Today's school students take different subject units and options, and even the concept of a study week can vary. However safety concerns and legal liabilities have put the onus on school administrators to know where any student is, at any time. The Australian made ASP ClassNet Automated Attendance Terminal is designed to provide a cost-effective answer to this problem. One swish of a barcoded ID card by the student entering a class and their attendance is recorded — in a fraction of the time it takes to call a roll.

The rugged, inexpensive terminal is wired back to the administrative computer, which can be a simple PC. Information is securely stored in non-volatile memory for instant collection and sorting by the computer. From there it can be posted into a spreadsheet for rapid analysis of the data, or manipulated via third-party packages which have been specially written for use with Asp ClassNet.

ClassNet cards can also be used as library cards, and services are available which will imprint them with the student's photograph. The ClassNet terminal also allows the use of Touch Memory ID tags.

For more information circle 201 on the reader service card or contact ASP Microcomputers, 456 North Road, Ormond 3204.





with the same high standard of useability and rich feature set that has won the product 31 awards for excellence, and distinguished it as Software Product of the Year in *Windows Magazine*.

LapLink for Windows NT offers high productivity and security with its seamless integration with the Windows NT 32-bit architecture. Designed to leverage Windows NT 4.0 security, it supports user profiling and defined access rights — features vital to network administrators who need to secure and manage Windows NT systems. Unlike most of its competitors LapLink also supports 64-bit addressing, making it possible to remotely access and transfer large files (over 4GB) without conflict.

LapLink is distributed in Australia by Tech Pacific and Marketing Results and is available at computer retailers and resellers. The list price for LapLink for Windows NT is \$249.00. It ships on a CD-ROM and comes with a 'make disk' utility. The NT version also includes LapLink for Windows 95 in the box, a serial cable and two manuals (NT/95).

For more information circle 202 on the reader service card or contact Traveling Software Australia, 14 Spink Street, Gardenvale 3186.

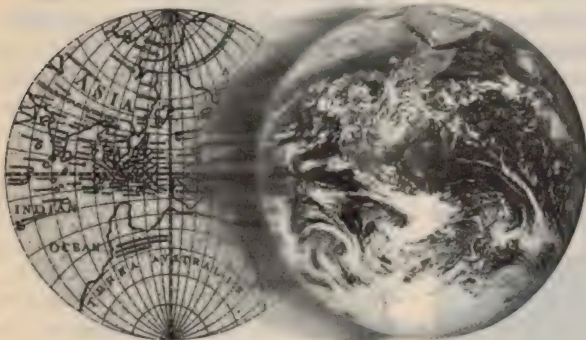


### RS422 fibre optic modem

The OSD135 asynchronous RS422 modem is a direct replacement for twisted-pair extension cables. It provides extended links of up to 5km while providing EMI/RFI protective data security, reduced data error rate and elimination of ground loops.

The OSD135 supports full duplex asynchronous data rates up to 1Mb/s. This unit is also available for single-mode fibre where it will operate up to at least 10km.

For more information circle 203 on the reader service card or contact Optical Systems Design, Unit 7, 1 Vuko Place, Warriewood 2102. ♦



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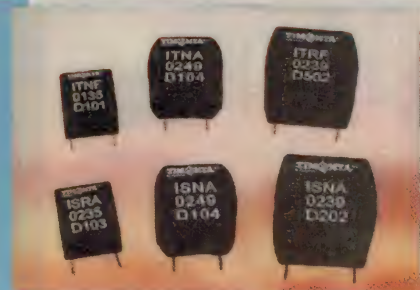
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# SPOTLIGHT ON SOFTWARE



## CircuitMaker Design Suite

The CircuitMaker Design Suite is a combination of CircuitMaker schematic capture/circuit simulation software and TraxMaker, a PCB design program. Developed by MicroCode Engineering and distributed in Australia by Lab-Volt, this fairly comprehensive package is easy to use, and is perhaps the cheapest full-featured electronic design suite around at the moment.

by **GRAHAM CATTLEY**

OK, so you aren't a large engineering firm able to lay out thousands of dollars on big impressive schematic capture and PCB design software. You also don't want to waste what money you do have on a design package that isn't up to the job. So what do you do? Well, you could certainly take a look at the CircuitMaker Design Suite — it consists of two separate programs, CircuitMaker and TraxMaker, and they combine together to provide quite a powerful circuit design package.

At \$899, the Circuit Design Suite isn't exactly freeware, but it is significantly cheaper than comparable electronics design packages, and you can buy either CircuitMaker or TraxMaker separately for \$495 each if you want.

Installing CircuitMaker and TraxMaker is fairly straightforward — if not a little surprising in that the software is supplied on a

number of floppies rather than the nowadays more usual (and cheaper) CD-ROM. This does have some benefits though, not the least of which is the fact that the software can easily be backed up, as no form of copy protection is used. The supplied manuals are also interesting, because unlike most other software manuals, they actually give you some relevant information. Top marks!

### CircuitMaker

This is the fifth version of CircuitMaker, and overall it is quite impressive. It performs analog and mixed analog/digital simulations, using the 3f5 version of SPICE3 as well as XSpice, and so offers full mixed mode simulation, operating point and transient analysis.

It's a true 32-bit program, and is designed to run under Win95 or NT. You can run it under Windows 3.1x though, by installing

Win32s (this is done automatically as part of the installation if needed). The system requirements are quite modest, with a minimum of a 386 with a VGA graphics card and 10MB free on the hard drive. Part of that 10MB is taken up with over 1500 CircuitMaker components, some of which are quite complex, like the two-line by 16 character LCD screen. As well, SPICE libraries from other sources can be easily imported, as can component models direct from component manufacturers.

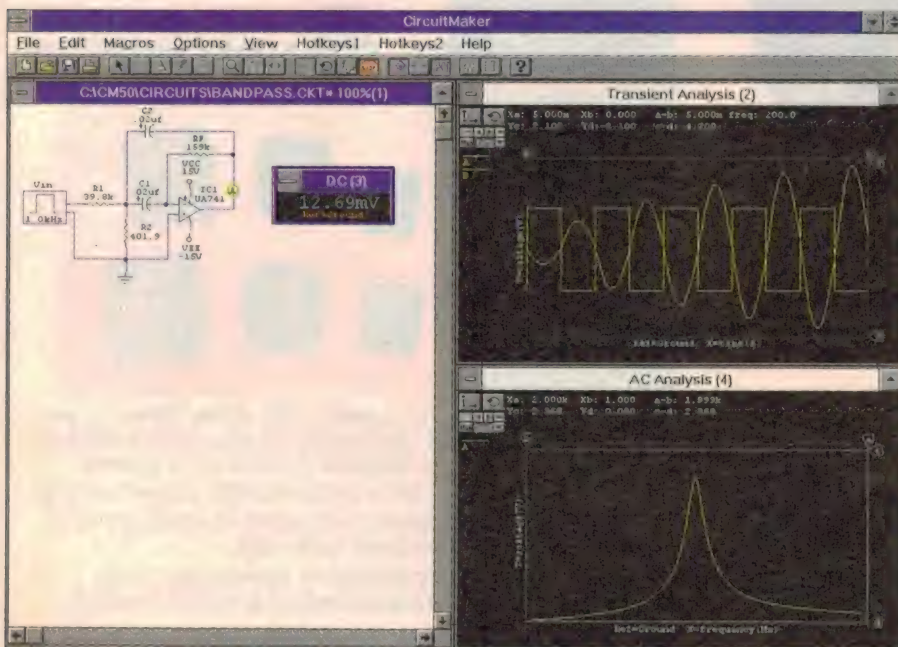
So, what has CircuitMaker got going for it? Well, a major selling point is the fact that it will support any number of oscilloscopes, meters and other pieces of test equipment in the simulation. This is in contrast to other simulation packages that only support one of each instrument, which then have to be moved around if you want to perform a series of different measurements.

On the digital simulation side of things, purely digital circuits can be simulated 'on the fly' as it were, with a logic probe-like tool allowing you to probe around to see what's going on. There is an option to have each wire turn red as it swings to a logic high, but I found this rather distracting with circuits containing more than a few gates.

Simulation can be stopped at any point (or once a certain set of conditions are met), and can then be single-stepped if necessary through a critical stage of the circuit's operation.

Analog circuit simulation is performed an entirely different way, however. Instead of the usual system of continuous circuit simulation, which tends to operate on something like a 1000:1 time scale, CircuitMaker performs the whole simulation in one fell swoop, and then lets you perform all your measurements afterwards. This means that any measurements you make are displayed instantly (as all the calculations have already been done), giving the simulator a very snappy feel.

This system works particularly well with instruments like the oscilloscope, and most of CircuitMaker's graphing functions as



**A circuit being simulated by CircuitMaker, with both transient analysis and AC analysis being used. Each graph is updated every time the mouse is clicked on a new node in the circuit.**



*Here TraxMaker is being used to modify an existing Protel Autotrax file. The few tools in the bar along the top are all you need to create quite complex boards from scratch, or you can always import a netlist from CircuitMaker.*

well. In the AC Analysis window you can plot almost any two parameters against each other (voltage vs frequency for example), with the plot instantly updated each time you select a new node in the circuit.

## Test equipment

As I said before, you can have as many pieces of test equipment as you want in the circuit, and there are a number of different types to choose from. They're all well designed and quite configurable, making them very easy to use. Take the multimeter for example; it can measure AC or DC volts, resistance, current and power, but to use it you just click in the wire or component you are interested in. The meter automatically changes to the correct function depending on where in the circuit you clicked: Click on a component, and it will tell you the power being dissipated, click on a component lead and it measure the current flow, and so on.

As well as the multimeter, there's an oscilloscope, a curve tracer, a bode plotter and a data sequencer for digital circuits.

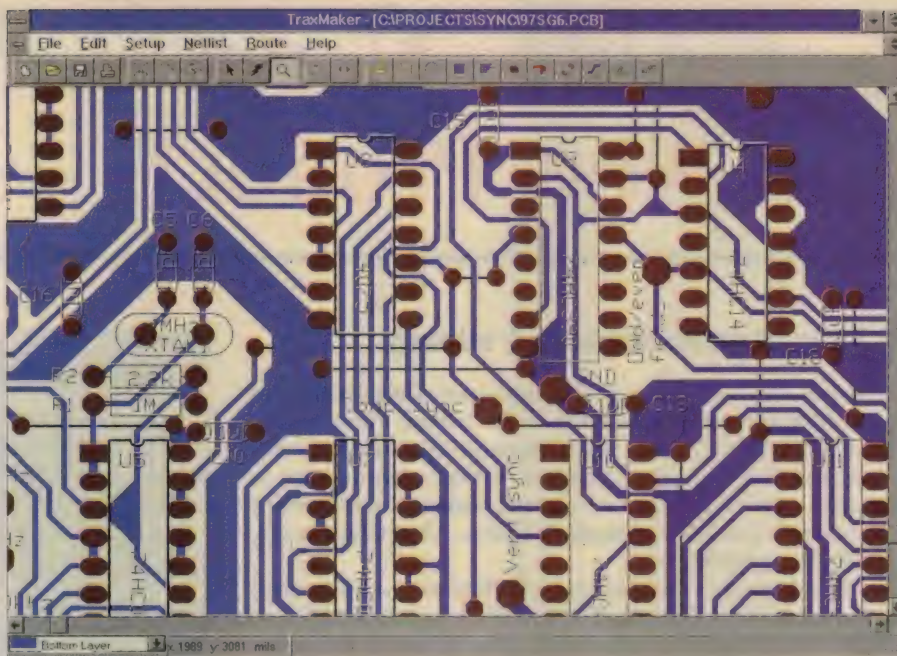
Other features of CircuitMaker include an easy to use macro editor for making up your own components, and this is linked to a very capable symbol editor that lets you design a new schematic symbol for it, or even modify the symbols for existing components. (Nice, if like me you want bigger zig-zags on your resistors.)

There's an extensive fault injection system for setting up troubleshooting exercises (which I must say I didn't have time to try out), as well as the interesting idea of animated components. These are things like rockets and racing cars, designed to take off or race along when triggered, and they certainly add a bit of life to the circuit's operation.

## TraxMaker

Having played around with CircuitMaker for a while, I moved on to TraxMaker, the PCB design side of the CircuitMaker design suite.

After installation (the media and system requirements are identical to CircuitMaker), I was pleasantly surprised to find that it was very similar to Protel's Autotrax, the DOS-based program we use to design our own boards here at EA. No, wait a minute, it was *exactly the same* as Autotrax, only 'windowed'. Nearly all the menus submenus and options were familiar, and so within minutes I was zooming around designing a little test PCB. There were differences, as you would expect, but the overall look and feel of the package meant that I could jump straight in without even looking at the manual.



The program has been ported over to Windows so thoroughly that even some of the bugs have carried over as well. I noticed that the 'zig-zag' bug was still in evidence, where the track node list sometimes gets corrupted if two tracks have the same start and end points. A new bug (I assume it's not a 'feature') is that when moving a fill, the fill jumps to the mouse cursor, rather than the other way around, making it impossible to shift fills a couple of clicks as you could in the DOS version.

Having used the DOS version of the program for so long, I often felt a little frustrated by the lack of keyboard support in this Windows incarnation. Some of the keyboard commands were carried over, such as 'End' to redraw the screen, and '+' to change layers, but would it have been that hard to provide a bit more keyboard support? Things like moving the cursor with the keypad, or assigning commands to the function keys would have made things a bit easier. Maybe I'm being a bit picky, but having to move the mouse up to the toolbar every time you want to change tools seems clumsy, particularly if you've just carefully positioned the cursor on the board.

Still, this is all made up for by the printing facilities provided, which are a positive joy to use. Every aspect of the printout is fully controlled by a series of well laid-out radio buttons, and you can easily select the layer, size, orientation and of course positive or negative output. Printing is performed through the normal Windows printer driver, and I was more than pleased by the resulting printouts.

You can also produce Gerber plot and Excellon N/C drill files; the TraxMaker manual goes into some detail on this matter, and is well worth reading.

TraxMaker can produce through-hole and

SMD boards, and supports up to six signal layers plus mid-layer power and ground planes. Boards can be as large as 32 inches square, with resolution of one thou (.001"), and you can toggle from an imperial to a metric grid system as you work.

As part of the TraxMaker Design Suite you can of course import netlists generated by CircuitMaker as well as a number of other schematic capture packages.

## Conclusion

All up, I was more than happy with the performance of CircuitMaker, and while I did grumble a bit about Traxmaker, it was only because I am so familiar with the DOS version. Anyone coming at this package anew would, I think find it friendly and easy to use, and quite powerful and flexible as well.

You don't have to take my word for it though; demo versions of both CircuitMaker and TraxMaker are available from Lab-Volt's web site (<http://www.ozemail.com.au/~ttsvolt>). Download them and try it all out for yourself — I don't think you'll be disappointed. ♦

## CircuitMaker Design Suite

**Good points:** Fast, snappy, and comparatively cheap.

**Bad points:** Some minor niggles in TraxMaker, but nothing serious.

**RRP:** \$899 for CircuitMaker and TraxMaker together, or \$495 each separately.

**Available:** Lab-Volt, PO Box 289, Ingleburn NSW 2565. Phone (02) 9605 2455, or fax (02) 9829 1296. Email [ttsvolt@ozemail.com.au](mailto:ttsvolt@ozemail.com.au).



# Computer News and New Products



## PCI-based video capture & editing

Miro has released a new version of its award winning digital video editing solution for PCI-based Windows 95 systems. The new solution, miroVIDEO DC20 plus, offers improved digital video quality, user enhancements, and more versatility through video overlay, an impressive collection of software, and bus mastering which delivers higher data rates and lower compression ratios. All of this comes for an RRP of only \$1190.

Included in the package is including the following software products: Ulead Systems' MediaStudio Pro 5.0 VE, with an MPEG conversion tool for advanced video editing; Vivo Software's VivoActive Producer 1.0, for video streaming over the Internet; and Sonic Foundry's Sound Forge XP 4.0 for audio editing.

The miroVIDEO DC20 plus card, with PCI bus mastering delivers improved data rates up to 4.0MB/s and M-JPEG compression of 4.4:1 at full-screen 768 x 576 PAL resolution, producing excellent video image quality. The card also boasts real time video overlay on the computer monitor, eliminating the need for an external video moni-



tor. In addition, the package supports S-VHS, Hi8, VHS and Video8 formats along with Composite and S-Video input and output.

For more information circle 160 on the reader service card or contact distributors Lako Vision, 2/3 Wellington Street, Kew 3101.



## CD-RW drives

Protac International Computers Australia have announced several new additions to Ricoh's line of dual-function recordable/rewritable CD-RW drives, claimed to make recording or rewriting data onto CD media as easy as storing data onto a floppy disk. The new releases include two internal CD-RW SCSI drives, Models SCSI 6200s and SCSI 6201S, as well as a new IDE drive Model IDE 6200A.

Both base models SCSI 6200s and IDE 6200A come with a 1MB buffer, while model SCSI 6201S has a 2MB buffer to enhance data-writing capabilities.

Drives for Windows 95 systems are bundled

with Adaptec's Direct CD and Easy-CD Pro software. SCSI drives for Macintosh systems are compatible with Toast mastering software, purchased separately at the user's cost.

Easy-CD Pro 95/NT premastering software supports a broad range of formats including CD-ROM (Mode 1), CD-ROM XA (Mode 2), CD-DA, and mixed mode (CD-ROM + CDCA) and is designed to offer maximum performance, flexibility and reliability when used to record sophisticated video, audio, multimedia, desktop publishing, internet or games files.

For more information circle 164 on the reader service card or contact Protac International Computers Australia, Unit 3, 28 Martha Street, Granville 2142.

## Compact barcode readers

ASP's Palm Portable and DataGlove are claimed as important new directions in portable data collection. The Palm Portable and DataGlove both read barcodes, while the Palm Portable also reads Touch Memories.

In both devices scanned/read data is stored in miniature waterproof ASP Data Tags, which can retain data for up to 10 years. This way the data can be taken to the computer for download, while the Palm Portable or DataGlove can stay on the job. By exchanging Tags they have virtually unlimited memory.

Neither product requires battery charging; power for several months' work comes from disposable batteries. The Palm Portable reads barcodes with a simple flick of the wrist, and Touch Memories by touching them with the special inbuilt socket. The DataGlove is based on a compact 35mm CCD Auto Touch





Scanner. Just place the DataGlove over a barcode and touch the read switch. Both products can share Data Tags and have a clock/calendar to time and date stamp data.

For downloading, ASP's Data Tag Homebase connects to the COM Port of a PC. Tags are simply slipped into the

Home Base (just like using a very small disk drive). ASP's software senses the presence of the Data Tag and downloads it on command. The download software also maintains a library of individual ASP Data Tags, as all contain a unique computer readable serial number.

Applications for the technology range from student assessment and stocktakes to time costing, auditing of service provision, and invoicing.

For more information circle 161 on the reader service card or contact ASP Microcomputers, 456 North Road, Ormond 3204.

## New anti-virus suite from Cybec

Australian anti-virus software specialist Cybec is launching a new version of its very successful Vet package. The new Vet Anti-Virus Suite is designed to target specific niche markets, through retail channels as well as Cybec's Australia-wide direct sales team.

A key element of the new suite is the use of web technology to keep the price down. "One of the major changes we have made is to pass on web savings to our users", says Frances Ludgate, Vet's Marketing Manager. "Vet Net Surfer, with an RRP of \$99, is aimed squarely at experienced or new Internet users — all upgrades are on-line and the product still has the full technical support, which we are renowned for."

"There are considerable savings in using the Internet to distribute the software to our customers and we will be reducing the

cost of the ongoing upgrade service for home users who have Internet connection", continued Frances. "At the same time, we have retained Vet Premium — a service with mailed quarterly upgrades and an RRP of \$129, for users who are not web-connected and for those who like to have the reassurance of the physical disks arriving on their desk."

The product range targets the SOHO and SME areas, organisations with anything from 1 to 100 PCs, with the Vet Enterprise range. Multiple-user licences are available over the shelf at very reasonable prices: Vet Enterprise 2-user for \$179, Vet Enterprise 5-user for \$299 and Vet Enterprise 10-user for \$499.

For users wishing to evaluate before they spend \$99, or for those wanting a quick fix to a virus, the Vet Starter Kit at just \$19.95 RRP provides the ideal solution. It contains all operating systems — Windows 95, Windows NT Workstation, Windows 3.x



and DOS — and manuals in both HTML and PDF formats. It comes on CD complete with vouchers for discounts off the Vet range.

For further information circle 162 on the reader service card or contact Cybec, 1601 Malvern Road, Glen Iris 3146.

# EML-2M

## EPROM EMULATOR

Can emulate two different ROM's or RAM's simultaneously!

The EML-2M ROM/RAM Emulator allows two different ROM's or SRAMS to be emulated from 64Kb to 1Mb, or 1 ROM or SRAM up to 2Mb. EML-2M is an easy to use and economical development tool suitable for general firmware development. It saves EPROM

consumption and cuts time wasted in repetitive programming and erasing.

The software provided can quickly download files in either HEX or BINARY format to the emulator. A full screen editor enables modification in HEX or ASCII format.

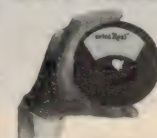
- Can emulate 4Mb to 8Mb after expansion.
- RESET/HALT can be activated on the target board
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## Scalable 10/100Mb/s ethernet switch



Intel Corporation has introduced the Intel Express 510T Switch, a sealable workgroup switch that provides 10/100Mb/s (megabits/second) connectivity directly to the desktop.

The sealable switching solution offers the features typically found in more expensive

chassis-based solutions, including flexibility, expandability and fault tolerance, while providing the affordability and ease-of-use characteristic of stand-alone switching options. While the 24-port switch is currently capable of scaling up to 56 ports, future product releases will extend the Express 510T Switch's scaling capacity to 196 fully-managed ports.

The Express 510T Switch's flexible base unit and 10/100Mb/s auto-negotiation feature that recognises 10Mb/s or 100Mb/s speed at each port, allows the transition to Fast Ethernet to take place at the desktop. This enables users with differing needs to exist in the same workgroup environment and gives network administrators the ability to control the costs associated with migrating large groups of users to higher bandwidth solutions.

With two expansion slots, the switch can accommodate additional TX ports, fibre con-

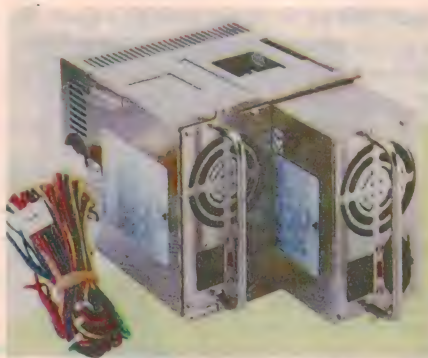
nections and a stack interface module for scaling multiple switches. Additionally, the switch supports an easy migration path to Gigabit Ethernet.

For more information circle 167 on the reader service card, contact your nearest Intel distributor or Intel Australia, Level 2, 8-22 West Street, North Sydney 2060.



## Compact PC casing

The new Advantech MBPC-200 series of PC casings is a cost effective solution for limited space and/or harsh environment applications. The industrial grade casing is specially designed to accommodate one of several types of Advantech 386 or 486 processor-based SBCs, such as the PCM-4824, the PCM-4822, the PCM-3864 and the PCM-3860. This convenience saves one the trouble of locating or custom building a computer casing. Examples are vehicle PCs and machine/equipment con-



trollers, and soft PLC's.

The casing is not only space efficient (smaller than a 5.25" FDD — 190 x 114 x 39.5mm), but it's also easy to expand. By using industry standard PC/104 modules, it is possible to easily add extra functions as audio, video and communication. Furthermore, the MBPC-200 series is compatible with most off-the-shelf software, which helps system designers significantly reduce development time and cost.

For more information circle 163 on the reader service card or contact Priority Electronics, 189 Bay Road, Sandringham 3191.

## Hot-swappable redundant power supply

Intelligent Systems Australia has released the RPI-300/400 series of power supplies. The supplies feature a balanced load sharing design for power redundancy with zero transfer time, with a hot-swap function which makes it easy

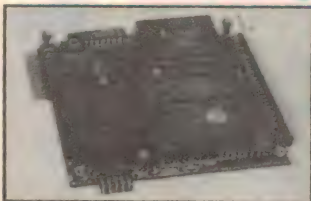
to replace one of the redundant power supplies when it fails or breaks down. They also include a warning buzzer to indicate if any one of the power supplies fail and warning LED's are provided with the power supply.

The RPI-300/400 has input characteristics of 90-132V AC or 180-264V AC

switchable, 47-63Hz and an input current of 6.2A/3.1A (115/230V). Dimensions are 183 x 190 x 170mm.

For more information circle 165 on the reader service card or contact Intelligent Systems Australia, PO Box 118, Berwick 3806. ♦

## Australian Computers & Peripherals from JED... Call for data sheets.



### Australia's own PC/104 computers.

The photo to the left shows the JED PC540 single board computer for embedded scientific and industrial applications.

This 3.6" by 3.8" board uses Intel's 80C188EB processor.

A second board, the PC541 has

a V51 processor for full XT PC compatibility, with F/Disk, IDE & LPT. Each board has two serial ports (one RS485), a Xilinx gate array with lots of digital I/O, RTC, EEPROM. Program them with the \$179 Pacific C. Both support ROMDOS in FLASH. They cost \$350 to \$450 each.

### JED Microprocessors Pty Ltd

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**\$130 PROM Eraser, complete with timer**

**\$300 PC PROM Programmer.**

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This little box simply plugs into your PC or Laptop's parallel printer port and reads, writes and edits PROMs from 64Kb to 8Mb. It does it quickly without needing any plug in cards.

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(Sales tax exempt prices)



# WEBWATCH



presented by GRAHAM CATTLEY

## Pitsco's Ask an Expert

<http://www.askanexpert.com/askanexpert/>

Got a problem? Well, you're probably best off asking an expert in the field, and there's probably no better place to get in touch with that expert than at this site.

The idea is similar to the Mentor system originally devised by Hewlett-Packard, where school students around the world can get help in their studies from engineers; only in this case you can ask questions on almost any subject, from molecular biology to solar heating.

The site is subdivided into 12 broad categories, each containing lists of people who have volunteered to answer questions that relate to their field of interest and work. If there is a relevant web page that could supply an answer, it is also listed along with the email address of the expert concerned.

Once you've found someone who can help you, you email them directly and they reply to you personally — nothing goes through the web site, which acts merely as an index.

So if you have a burning question on relativity, or simply want to know what aardvarks eat, why not ask someone who knows the answer?

## Short Circuit Website

<http://www.zip.com.au/~troy/index.html>

This is a fairly new Australian electronics site that has been put together by Troy Thompson, and it offers a lot more than the usual list of links. Probably the most useful feature is the WWWBoard, where you can post and answer questions on electronics and related subjects. When I looked there were only a couple of queries, but the site had only been up and running for a couple of weeks. There are of course link lists for all the major semiconductor manufacturers, and links to several circuit and schematic and software sites as well.

I encountered a few minor problems navigating some of the pages, but it is early days yet and I'm sure the wrinkles will soon get ironed out.

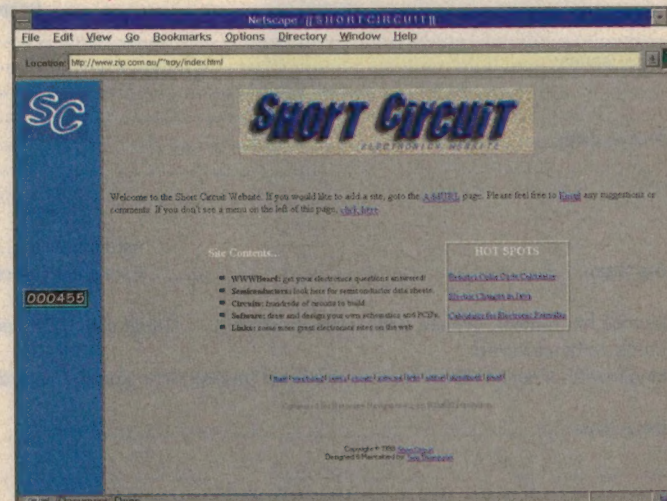
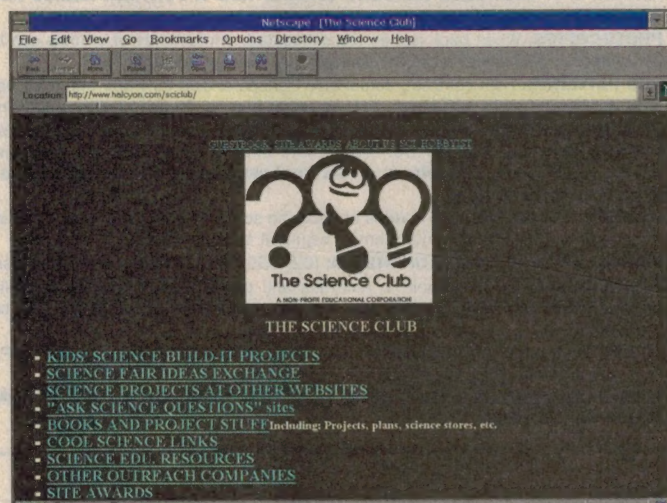
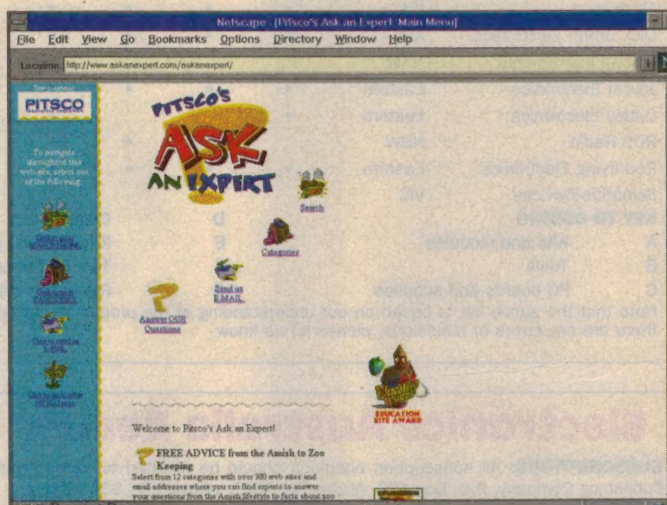
What this site needs is support. Troy asks for any URLs, information, suggestions or comments, and with a bit of feedback this could become quite a good electronics site. Go and have a look, bookmark it, and submit anything you think would help. With any luck the site will really take off.

## The Science Club

<http://www.halcyon.com/sciclub/>

The Science Club is an educational site with the aim of making science easy, interesting and above all, fun. Directed more towards younger people, and school Science Fairs in particular, this site brings together projects, ideas and suggestions from contributors around the world. You can leave a message about your own science project, offer suggestions, and arrange to swap data with someone running a project similar to your own.

You can see from the screen shot the sorts of facilities available, but the most interesting is the list of fun and easy to build science experiments. Everything from a smoke ring launcher or an ultra-simple electric generator, up to a VanDeGraaf machine or MAGLEV device. Details on the construction of each project is provided, along with links to useful web sites. It's all good fun, so if you have a spare weekend you now have no excuse not to come up with your own holograms, antibubbles, or even an antigravity chamber... ♦





# EA DIRECTORY OF SUPPLIERS

Which of our many advertisers are most likely to be able to sell you that special component, instrument, kit or tool? It's not always easy to decide, because they can't advertise all of their product lines each month. Also, some are wholesalers and don't sell to the public. The table below is published as a special service to EA readers, as a guide to the main products sold by our retail advertisers. For address information see the advertisements in this or other recent issues.

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## KEY TO CODING

A	Kits and modules	D	Components
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Note that the above list is based on our understanding of the products sold by the firms concerned. If there are any errors or omissions, please let us know.

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**SUBSCRIPTIONS:** All subscription enquiries should be directed to: Subscriptions Department, Federal Publishing Company, P.O. Box 199, Alexandria 2015; phone (02) 9353 9992.

**BACK ISSUES:** Available only until stocks are exhausted. Price A\$7.50 which includes postage within Australia only. **OVERSEAS READERS SHOULD ADD A FURTHER A\$2.50 FOR EVERY BACK ISSUE REQUIRED.**

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**PCB PATTERNS:** High contrast, actual size transparencies for PCBs and front panels are available. Price is \$5 for boards up to 100sq.cm, \$10 for larger boards. Please specify negatives or positives.

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**OTHER QUERIES:** Technical queries outside the scope of 'Replies by Post', or submitted without fee, may be answered in the 'Information Centre' pages at the discretion of the Editor.

**READER SERVICES BULLETIN BOARD:** (02) 9353 0627; ANSI, 24 hour access; any rate to 28.8kb/s.

**PAYMENT:** Must be negotiable in Australia and payable to Electronics Australia. Send cheque, money order or credit card number (American Express, Bankcard, Mastercard or Visa card), name and address (see form).

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As part of our service to readers, Electronics Australia operates a Reader Information Service Bulletin Board System (BBS) which makes available a wide range of useful information for convenient access and rapid downloading. You can also leave contributions to some of our columns. The BBS is ANSI compatible and is currently operational for virtually 24 hours a day, seven days a week, on (02) 9353 0627. Use any speed up to 28.8kb/s.



# Where do you GO for the last word in electronics...

*You go to the name that's been around the longest to get the latest products.  
The most experienced company with the newest look.*

## Snap up a Nikon Digital Camera

This Nikon beauty has 640 x 480 resolution and holds 132 normal images or 66 fine ones. JPEG format, 4MB internal flash memory, built-in auto-flash and speaker, 17 minutes audio storage, self timer, macro lens from 14 to 23 cm, 6.2 mm lens (equivalent to 45 mm lens in 35 mm format), 1/30 - 1/2500 sec shutter speed. Equivalent to 100 ISO sensitivity, 2.5" TFT LCD write-on touch screen/ display + viewfinder. G 0974

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## Video Sender

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**\$89<sup>95</sup>**

## Complete Control with the Home Producer Remote

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## Home Video Master

Add background music and narration to home videos with the Dynasonic Stereo Mixer. A 8401

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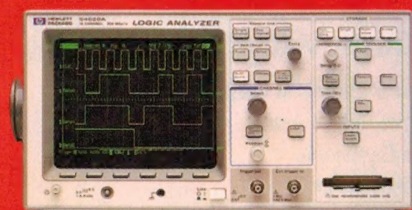
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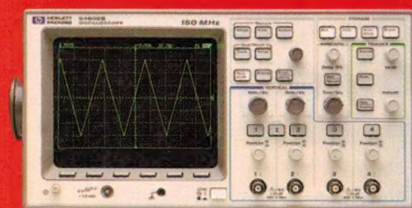
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